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ELECTRICITY AND GAS.

The question as to which of these two illuminating agents is the more economical for the purposes of lighting our streets is just now receiving a considerable amount of attention. Both have able advocates, but those in favour of gas have certainly the most exhaustive data to base their arguments upon; and we may generally consider the figures given by well-known engineers connected with our Gas Companies as reliable, so far as street lighting by the ordinary burners which are generally employed is concerned. But with new and improved burners, especially those giving a high illuminating power, the figures given by observers differ as we shall presently show. A correspondent writing to us last week gave the following results regarding the Siemens Regenerative Gas-burner, which is now employed for lighting that part of Holborn from the Circus to Gray's Inn Road. In a certain size of burner, the consumption of 30 ft. of gas per hour gives, it is said, a flame of 120 candles; whilst a larger one, consuming 100 ft. per hour, yields a light of 1,000 candles. It will be seen from this, that with a little more than three times the amount of gas consumed, we get an increase in illuminating power of eight times approximately; or if we consider it from another point of view, and divide the 100 cubic feet of gas amongst a cluster of three of the burners constructed to consume 30 ft. per hour each, we get a light of—say, 400 candles; and by utilising this volume of gas in a single burner of the larger size, we increase our light 2½ times. Our contemporary, the *Engineer*, however, gives a less satisfactory result concerning this same system of gas-lighting.

> In Holborn twenty-four lamps have been erected, the consumption of which ranges between 22 ft. and 24 ft. of gas per hour, with an average illuminating power per lamp of 130 candles. In addition to these Messrs. Siemens have fixed two large lamps, one at either end of the Holborn Viaduct, each of which, burning 65 ft. of gas an hour, gives a light equal to 400 candles.

Here it appears that three times the consumption of gas gives only thrice the amount of light, although it must not be forgotten that these burners, as compared with the best of the ordinary street gas jets give, according to these figures, about 70 per cent. more light for the same consumption of gas.

Now turning to the electric light, the following extract from the report of the Meeting of the Court of Common Council, held on the 30th March, will be of great interest to both parties, and will probably create feelings in each of a different nature:—

> At the meeting of the Court of Common Council, Mr. Felton, Chairman of the Court of Sewers, stated that of the three electric lighting systems now being tried experimentally in the City, that of the Brush was about the same price as gas, the Lontin (?) was twice the cost, and the Siemens nearly four times the cost. The Brush patentees had given notice to increase their contract price 10 per cent., and the Siemens authorities also contemplated increasing their estimate to five times the cost of gas in the same area. As to the new effective gas-lighting in Fleet Street, he might state that it was over four times the cost of the Brush system in the same district.

Although the gas companies have doubtless accurate figures to rely upon, we cannot say so much for those interested in the introduction of the electric light into our streets. We believe the amount paid for lighting the district occupied by the Brush system was, last year, £30 cheaper than had been previously paid for gas. It is difficult to imagine that the Anglo-American Brush Electric Light Corporation were not working at a loss, and the same remark applies to their present estimate, 10 per cent. over that of last year. We say this because it appears evident that Messrs. Siemens feel convinced that their contract, although at a price four times higher than that of gas, is not a profitable one to them, and that to continue the city lighting satisfactorily to themselves they wished to increase their estimate still further. However, in any case, the competing systems have not yet been compared in the way which would be most suitable for arriving at a definite conclusion concerning the comparative economy of gas *v.* electric light. We believe that Mr. Preece was amongst the first to advocate the test of each system lighting up a certain defined area to a *given standard of illumination*, and this we think is the only good test which has yet been proposed. What we require is that both systems shall have the same area to illuminate, and with the same number of lights, each of equal power, and then to compare the respective costs. It is very noticeable what a general degree of illumination is obtained on all portions of the pavements and road in Holborn, and the degrees of intense brightness and comparative shade are equally noticeable in Cheapside and Ludgate Hill. As a matter of fact we have till recent years tolerated street lamps of 15 candle-power at the maximum, and now in the last-mentioned streets we jump up to lamps of 2,000 (?) candles each. Certainly they are more limited in number, but then the illumination is not general. Taking Holborn as a fair example of first-class general lighting by arranging lamps at certain distances apart, and each one giving a light of 120 to 150 candle-power, whether obtained by means of gas or of electricity; then we think that at this candle-power electric-lighting by incandescence would have the advantage over gas for the following reasons. To get such an amount of light from gas, we burn, say, from 25 to 30 cubic feet per hour; now this amount of gas, utilised in a gas-engine, would give us about 1½ horse-power. Such a motive force would produce even in incandescent electric lamps of 15 candles each a total light of about 220 candle-power, but if the above horse-power were utilised in working a smaller number of incandescent lamps up to a higher candle-power, then our total light would be greatly increased. There is a certain point of illumination which we shall shortly hope to show, where the economy of gas and the electric light is identical, and on one side of this, that of the higher candle-power, it will be found more advantageous to employ the electric light, but for a lower standard of light it will be more economical to use gas. As the light produced by ordinary gas burners when multiplied is apparently proportional to the amount of gas consumed, whilst the degree of illumination from the electric light increases in a much greater proportion than the amount of current passing, it follows that for large lights—

say, of 150 candle-power and upwards, the latter will be found cheaper; but as we can divide up a given volume of gas into a number of small jets without any appreciable loss, whereas division in the electric light entails great waste, gas will have the priority for low standards of light. Therefore the best conditions for lighting our streets economically by means of gas so as to diffuse the light generally would be to employ double the number of lamps we have at present in *ordinary* use. Our remarks referring to large lights are corroborated by the last sentence of the paragraph we have quoted relative to the lighting of Fleet Street, and they apply still more strongly to the Siemens regenerative burner as used in Holborn.

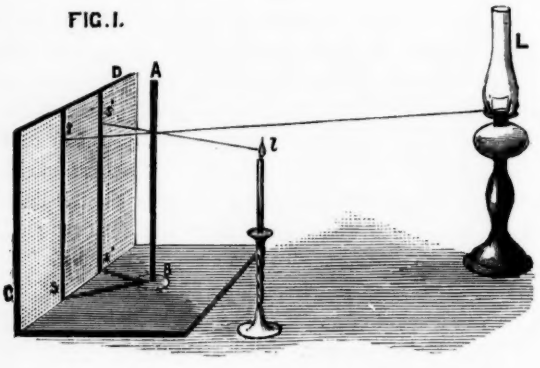
ON PHOTOMETERS.

II.

PHOTOMETERS IN WHICH THE EFFECT OF THE STRONGER LIGHT IS WEAKENED BY DISTANCE.

Rumford's Photometer.—In conformity with general usage we will continue to designate the photometer published and re-invented by Rumford,* by his name, although it it identical with that invented and published by Lambert, in 1760, which we mentioned at the conclusion of our last article. Rumford's photometer is based upon the equality of the two shadows of an opaque body projected upon a wall by the two lights which are to be compared. If, for instance, the light of a paraffine lamp, L, is to be compared with that of a candle, *l*, the apparatus is arranged as in fig. 1, in a room containing no other source of light

FIG. 1.



than those to be measured. The opaque cylindrical rod, A B, a little thicker than a blacklead pencil, is placed in front of the white screen, C D, and the two lights arranged so as to project the two shadows, *s s*, *s′ s′*, as near together as possible, and in such positions with regard to the screen that the inclination of the incident rays, *l* A *s′* and L A *s*, is the same. The stronger light, L, is then drawn back till the shadows appear to be of equal intensity. The shadow cast by either one of the lights is of course illuminated by the other light, while the remaining portion of the screen is illuminated by both the lights. It is evident, therefore, that the equality of the shadows indicates the moment when each of the lights gives an equal illumination to the screen. The relative illuminating powers or quantities of light of the two sources, *l* and L, stand in the relation of the squares of the distances (*s* L and *s′ l*) of the lights from the screen, or

$$l : \text{L} = (s'\,l)^2 : (s\,\text{L})^2$$

therefore

$$\text{L} = l\left(\frac{s\,\text{L}}{s'\,l}\right)^2$$

For example, a stearine candle 3 ft. from a screen, threw upon it a shadow of equal intensity to that thrown by a duplex paraffine lamp at a distance of 10 ft. The illuminating power of the lamp was therefore

$$\text{L} = l\left(\frac{10}{3}\right)^2 = l \times 11{\cdot}1$$

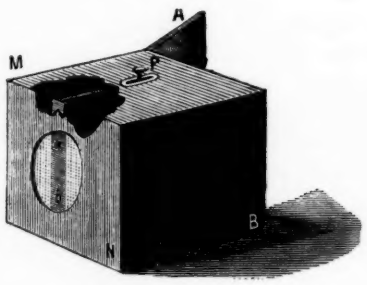
or 11·1 times the light-giving power of the candle.

This method of photometry is extremely convenient, as well as comparatively exact, and for this reason it has been very extensively employed. Given two lights, a blacklead pencil, a sheet of white paper, and a foot rule, and no one need remain in ignorance of the relative powers of illumination of the lights in question. This method is also sensitive provided only that the lights to be compared are capable of projecting distinct shadows upon the screen, but they must not be too near to it. Another condition of sensibility is as we have already mentioned, that the two lights should not be very different in colour, for a small difference in colour is easily recognised by the eye, and at once introduces an element of uncertainty.

Foucault's Modification of Rumford's Photometer.

The photometer—so called Rumford's—which we have described, has been modified and in some respects improved by M. Foucault, who has constructed a portable apparatus by which the shadows of a plate set up edgeways are cast upon a translucent screen, the comparison being easier and possibly more exact than with the original form of the apparatus.

FIG. 2.



Foucault's photometer is contained in a box, A, M, N, B, which can be opened by a door, A, at the back, A, B, and is provided in the front, M, N, with a circular opening, *a*, *b*, which contains the translucent screen. This screen may be formed by a plate of ground glass or by some translucent film, suitable to the illumination produced by the two lights. In the interior of the box is a plate of metal, the edge of which, by means of the button, P, on the top, can be shifted close to or removed from the screen, *a*, *b*. This plate is intended to fulfil the same function as the opaque rod in Rumford's photometer, that is to say, to throw two shadows on to the screen, *a*, *b*, corresponding with the two lights under comparison, which are placed at distances behind the box, one on the right and the other on the left hand side of the prolongation of the plate. In order to render the shadows of the plate as defined as possible, the interior of the box as well as both sides of the plate are covered with black cloth. The edge of the plate next to the translucent disc, *a*, *b*, is also furnished with a strip of metal which increases its breadth. By moving the button, P, and with it the plate, the two shadows which are thrown upon the screen, *a*, *b*, may be made to approach towards or recede from each other. By shifting the plate close to the screen,

* "Phil. Trans.," vol. lxxxiv., p. 67.

the shadows become separated by a dark band, and by increasing its distance from the screen they may be thrown apart, and so produce a lighter space between them. By adjusting the position of the plate the shadows may be made to just touch each other, and this position is the most favourable for obtaining a point of equality between the illuminated halves of the screen. In this modification the principal advantage over the original form of photometer is gained by the fact that the two shadows to be compared are not surrounded by spaces more strongly illuminated than themselves, and that a balance is therefore more easily adjusted. To calculate with this modification the relative light-giving power of the two sources, the same law obtains as in Rumford's photometer, the distances between the screen and the lights being ascertained, the relation of the squares of these distances gives the relation of the illuminating powers of the two sources of light.

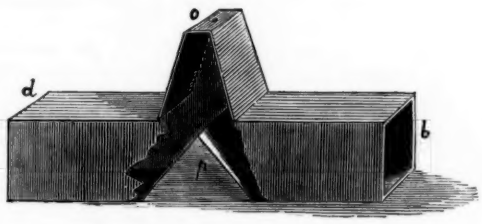
It may be mentioned here that Potter* also suggested the use of translucent screens. A still more important improvement in Foucault's photometer was made by Pernot,† who further illuminated the observed translucent surface by a third light placed in front, and which he gradually brought nearer to the face of the apparatus. If the illuminations of the two sides of the translucent surface are equal, their illumination must disappear at the same instant.

Ritchie's Photometer.‡

The improvement introduced by Ritchie consisted in the employment of a rectangular wooden prism, covered with white paper, and so placed that the observer, by having the two sources of light under examination on opposite sides of him, and regarding the prism from above, can compare the illumination of its two faces by varying the distances of the two lights.

Ritchie's photometer is based, therefore, upon principles identical with those of Rumford. In the middle of an oblong case, *a*, *b*, fig. 3, open at the ends, is a rectangular

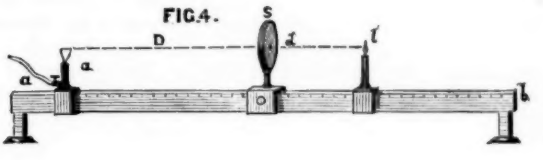
FIG.3.



prism of wood, *h*, so placed that the two faces which inclose the right angle form an angle of 45° in opposite directions with the horizontal and face the two open ends of the box. Vertically over the edge of the prism is an elevation of the box with a small aperture in the top, through which the operator observes the prism, *p*, the two sides of which are illuminated from opposite sides by the two lights, the two illuminated surfaces being only separated by the edge of the prism, and therefore close together and easily compared. The interior of the box is lined with black, and the observation is made in a dark room. A point of merit which Ritchie's photometer may claim over that of Rumford is in the two illuminated surfaces under comparison being in close proximity, by which the chances of obtaining an exact balance are greatly increased. But it is necessary to be careful that both the condition and angular position of the two faces of the prism correspond, otherwise to obtain exact results each observation should be checked by reversing the position of the photometer.

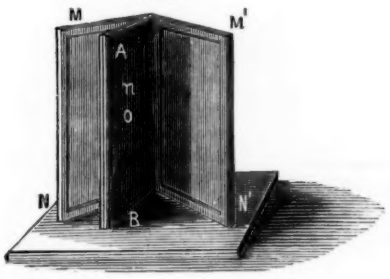
Bunsen's Photometer.—This photometer has the merit of extreme simplicity, but whether its exactness is equal to that of the preceding forms may be open to doubt. Bunsen's photometer consists principally of a screen of good white homogeneous paper, in the centre of which is a spot or stain, made with wax or stearine. White paper is, as everybody knows, translucent, that is to say, when a sheet of it is illuminated from behind, some light may be observed to pass through it. If the paper is saturated in wax or stearine it becomes still more translucent, more light passes through it, and if therefore a spot or stain of wax, &c., be made upon an otherwise clean sheet of paper, the spot in question appears lighter than the surrounding paper, so long as the light passes through it. But the reverse is the case when the sheet is illuminated from the same side as the observer, the wax spot then appearing darker than the rest of the paper, because proportionately more of the light is absorbed by the waxed paper than by the unwaxed. The light which falls upon a translucent object is employed in three ways: one part is reflected, another part passes through, and the remaining part is absorbed. The ratios of these three quantities to each other are different for different thicknesses of paper, and also for paper in its normal state and when waxed.

FIG.4.



The usual form of Bunsen's photometer is shown in fig. 4, in which *a b* is an optical bank, divided into feet and inches, or into centimetres. At one end is placed upon a suitable support the burner, L, which is to be compared with the normal candle, *l*, at or near the other end. The paper screen, *s*, with a central spot waxed or stearined, is attached to a slide, which is movable between the two lights, the balance being reached when the screen is equally illuminated from both sides, and the wax-spot disappears. Then the illuminating powers of the lights are proportional to the squares of their respective distances, D and *d*, from the screen. The total disappearance of the wax-spot in Bunsen's photometer is, however, a point which is seldom or never satisfactorily reached; and, moreover, it is generally found that when a balance is obtained the slightest shifting of the eye of the observer is sufficient to bring the wax-spot back again into view.

FIG 5



A very common modification of Bunsen's photometer is the so-called mirror photometer. It consists of a white paper screen with its wax-spot, mounted between two plane mirrors, so that the operator sees at the same time the reflections of both sides of the screen. The screen is placed in a small wooden frame, A B (fig. 5); M N and M′ N′ are the two mirrors, forming an obtuse angle, divided into equal parts (in plan) by the frame, A B. The operator placed in front sees the reflections of both faces of the screen. The two lights to be compared are situated one at the right hand, the other at the left, so that each face of the paper can only be illuminated by one of the lights, the distances of which are adjusted until the reflections of the central wax-spot disappear.

Wheatstone's Photometer, fig. 6, consists of a small bead of

* "Edinburgh Journal of Science," New Series, III., 284.
† "Moniteur Indust.," 1850, No. 1509.
‡ "Annals of Philosophy," Series III., vol. i., p. 174.

silvered glass, which is moved rapidly backwards and forwards in a straight line by means of a simple mechanical contrivance, the bead being attached to the circumference

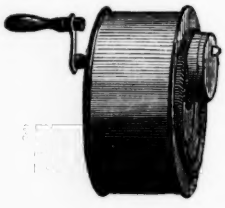


FIG. 6.

of a tooth-wheel revolving within a fixed annular wheel which has twice as many teeth. The operator stands between the two lights to be compared, which he sees reflected by the moving bead as two bright parallel lines. By altering the relative distances of the lights until the luminous lines appear to be of equal intensity, the required position is found which gives the two distances, the squares of which are proportional to the illuminating powers of the two lights. The principal advantage of this photometer is its portability.

ELECTRIC LIGHT MEASUREMENTS.

By H. R. KEMPE.

VI.

MEASUREMENT OF ELECTROMOTIVE FORCE.

BY means of the galvanometer, the standard cell, the set of high resistances (4,000, 3,000, 2,000, 1,000, 400, 300, 200, and 100 ohms), and the set of low resistances adjustable by units (40, 30, 20, 10, 5, 3, 2, and 1 ohms), referred to in article I. (Jan. 7th, page 7), the measurement of electromotive forces can be made with great facility.

The standard cell connected direct on to the tangent galvanometer will produce a deflection of about 45° due to an electromotive force of 1·079 volts. Now, if we remove the standard cell and connect the terminals of the galvanometer to—say, the terminals of an electric lamp (fig. 7), then the deflection obtained, compared with the deflection obtained with the standard cell, would represent the electromotive force between the terminals of the lamp. Strictly speaking, this is only correct if the resistance of the lamp is very small compared with the resistance of the galvanometer circuit; but practically, in "Electric light measurements," it is always the case that the resistance external to the galvanometer circuit can be ignored without causing any error worth taking into account.

Suppose, then, that the deflection obtained with the standard cell was $46\frac{1}{2}°$ ($\delta°$), and the deflection with the electromotive force, whose value is to be determined, was 49° ($d°$), then the value of the unknown electromotive force would be

$$1{\cdot}079 \times \frac{\tan 49°}{\tan 46\frac{1}{2}°} = 1{\cdot}079 \times \frac{1{\cdot}150}{1{\cdot}054} = 1{\cdot}178 \text{ volts.}$$

To measure an electromotive force of 2 volts a resistance, R (fig. 8), of 1,000 ohms should be inserted so as to increase the total resistance in the galvanometer circuit up to 2,000 ohms; in this case then the electromotive force represented by a deflection equal to that given by the standard cell will be twice that of the latter, and the value for any other deflection will be in proportion to the latter. To measure an electromotive force of 3 volts the total resistance in the circuit would be 3,000 ohms, or three times what it is for the standard cell, and so on. The general formula, in fact, for the test is:

$$\text{Electromotive Force} = 1{\cdot}079 \times \frac{R + 1000}{1000} \times \frac{\tan d°}{\tan \delta°} \quad (A)$$

where R is the resistance unplugged in the resistance coils, $\delta°$ the deflection given by the standard cell joined direct on to the galvanometer, and $d°$ the deflection given by the electromotive force whose value is required.

In making the test the object aimed at should be to bring the deflection of the galvanometer as near to 45° as possible by adjusting the resistance, R. Thus, for example, suppose when R was adjusted to 4,500 ohms the deflection $d°$ became 47°, then we should have:

$$\text{Electromotive Force} = 1{\cdot}079 \times \frac{5500}{1000} \times \frac{1{\cdot}072}{1{\cdot}054} = 6{\cdot}04 \text{ volts.}$$

To measure 10 volts according to the foregoing method the total resistance in the circuit would have to be 10,000 ohms, and as this is the greatest resistance which can be in the circuit, in order to measure higher values than 10 volts the galvanometer will have to be shunted by shunts placed between its terminals (fig. 9). This shunt can be obtained from the small set of resistance coils. To measure electromotive forces of from 10 up to 100 volts a $\frac{1}{10}$th shunt should be used; the resistance of this shunt would be $\frac{1}{9}$th of the resistance of the galvanometer, or $\frac{1000}{9} = 111{\cdot}1$ ohms, that is, 111 ohms approximately. This resistance would be obtained from the small set of resistance coils by removing all the plugs, since $40 + 30 + 20 + 10 + 5 + 3 + 2 + 1 = 111$.

The resistance of the galvanometer with the $\frac{1}{10}$th shunt connected becomes reduced from 1,000 to 100 ohms, so that

FIG. 7.

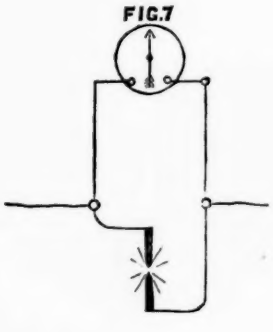


FIG. 8.

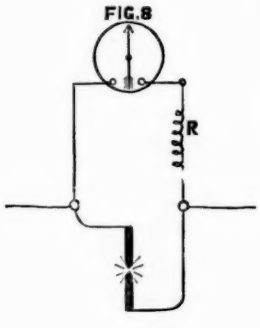
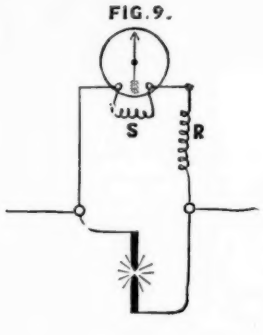


FIG. 9.



the *total* resistance in the circuit when a test is being made will be the resistance in the large resistance coils plus 100. The formula for measuring electromotive forces of from 10 to 100 volts therefore becomes:

$$\left.\begin{matrix}\text{Electromotive} \\ \text{Force}\end{matrix}\right\} = 10 \times 1{\cdot}079 \times \frac{(R + 100)}{1000} \times \frac{\tan d°}{\tan \delta°} \quad (B)$$

For example: a resistance of 111 ohms having been connected between the terminals of the galvanometer, a resistance R in the circuit of 6,200 ohms brought the galvanometer deflection to 43° ($d°$), then

$$\left.\begin{matrix}\text{Electromotive} \\ \text{Force}\end{matrix}\right\} = 10{\cdot}79 \times \frac{6300}{1000} \times \frac{{\cdot}933}{1{\cdot}054} = 75{\cdot}7 \text{ volts.}$$

To measure electromotive forces of from 100 to 1,000 volts we might adopt a similar arrangement to the foregoing by employing a $\frac{1}{100}$th shunt for the galvanometer. There is, however, a practical objection to this, for the reason that the measurement of a force of 100 volts would be made with a resistance of but 1,000 ohms in the circuit. Now, the higher electromotive forces are usually those between points which are separated by a comparatively high resistance, and consequently, in order that this latter may affect the correctness of the results as little as possible, it is advisable to have as much resistance in the galvanometer circuit as can be used. The resistance unplugged in the resistance coils when we are measuring an electromotive force of about 100 volts would be 10,000; and in measuring forces exceeding 100 it is advisable to keep this resistance always in the circuit, and to bring the galvanometer deflection to about 45° by adjusting the resistance in the small set of coils used as a shunt to the galvanometer. If s be the resistance of the shunt, then the combined resistance of the latter with the galvanometer is

$$\frac{GS}{G+S}$$

whilst the *multiplying power* of the shunt is

$$\frac{G+S}{S}$$

consequently the formula for measuring electromotive forces of from 100 up to 1,000 volts will be:

$$\left.\begin{matrix}\text{Electro-}\\ \text{motive}\\ \text{Force}\end{matrix}\right\} = 1{\cdot}079 \times \frac{1000+S}{S} \times \left(\frac{10{,}000 + \frac{1000 \times S}{1000+S}}{1000}\right) \times \frac{\tan d^\circ}{\tan \delta^\circ}$$

$$= 1{\cdot}079 \times \left(\frac{10{,}000}{S} + 11\right) \times \frac{\tan d^\circ}{\tan \delta^\circ} \quad (C)$$

a formula which can be worked out with numerical values without difficulty. Thus for example—suppose a shunt of 25 ohms (S) brought the deflection to 48° (d°), the deflection with the standard cell being as before, $46\frac{1}{2}$° (δ°) then—

$$\left.\begin{matrix}\text{Electromotive}\\ \text{Force}\end{matrix}\right\} = 1{\cdot}079 \times \left(\frac{10000}{25} + 11\right) \times \frac{1{\cdot}111}{1{\cdot}054} =$$

$$1{\cdot}079 \times 411 \times \frac{1{\cdot}111}{1{\cdot}054} = 467 \text{ volts.}$$

(*To be continued.*)

NOTES ON THE LAW AND PRACTICE RELATING TO LETTERS PATENT FOR INVENTIONS IN THE UNITED KINGDOM.

By T. J. HANDFORD.

[It has been thought desirable to publish the following papers, which we believe will prove of interest to many of our readers. Mr. Handford is the appointed patent agent in this country to Mr. T. A. Edison, which fact is in itself a guarantee that the author is conversant with the subject on which he treats.—Ed. Elec. Rev.]

Letters Patent are granted in the United Kingdom for *new and useful* inventions to the *first and true inventors* or *first importers* thereof.

I. Inventor.

By the term first and true inventor is intended the first *bonâ fide* inventor within the realm. Where several persons simultaneously discover the same thing, the person who first discloses it by applying for letters patent for it is considered the legal inventor. It frequently happens that the originator of an idea employs others to assist him professionally in developing it and putting it into a practical shape, and in those cases it is most difficult to determine what share of the credit of the invention is to be apportioned to each. If the invention has been carried out under the directions of the originator, his professional assistants are in the position simply of servants or workmen, acting under his instructions, and he alone is recognised as the inventor; but where the professional assistants have by their suggestions largely contributed to the success and practical embodiment of the original idea, they are properly considered as joint inventors with the originator. On the other hand, when the invention, both in its original conception and its development, is due to a servant or workman, the employer has no claim to any share in the benefit of the invention.

II. Importer.

Where a patent has been obtained by the first importer into the realm of an invention communicated from abroad, it cannot be upset on the ground of the invention having been acquired surreptitiously or in fraud of the original inventor. This condition of things is one of the most inequitable effects of the present law, and will no doubt be altered when an amendment of the law takes place.

III. Invention.

An invention is defined by the statute to be "*any manner of new manufacture.*" This term is held to include machines, mechanical and chemical processes and the results of such processes, under one or other of which heads may be classed all the multifarious inventions capable of forming the subject-matter of valid letters patent. The machines, mechanical or chemical processes, or the articles or products which are the results of such processes, may be either new in the whole of their parts, and employed for a new purpose, or such machines, processes, articles, or products may be composed of a new combination of old parts, and be employed for a known purpose; and between these two extremes may be arranged in a gradatory series an almost infinite variety of inventions, differing in the degree of novelty of their constituent parts, of the combination of such parts, and of their uses.

It frequently happens that a known machine, process, or material is applied to a purpose differing from that for which it has previously been used; and there are no classes of patents that give rise to more difficulty both to the legal profession and to the courts than do those which relate to inventions of this character, as the law views with suspicion all patents the subject-matter of which is a mere *application* of something previously known or used. In such cases the determination of the question as to the patentability of the application depends upon the degree of analogy between the former use of the machine, process, or material, and the new purpose to which it is intended to apply it. In order for the patent to be sustained, the new application must be so out of the common track as not to be likely to have suggested itself to a person acquainted with the previous application. Very much, however, depends upon the value and importance of the result obtained, as it is quite immaterial whether the invention is merely due to a sudden happy thought, or whether it was only arrived at after a long course of experiment, provided the advantage accruing to the public from its use is sufficient to stamp a *bonâ fide* character upon the invention itself.

A mere slight addition to a known machine or process has frequently been found to effect a considerable improvement in the result obtained, and where this is the case such addition constitutes proper subject-matter for letters patent; it being of course understood that if the known machine or process itself forms the subject of an existing patent, the second invention cannot be used without the licence of the owner of the original patent.

It will be seen from the foregoing that what the law requires in an invention is a *substantive* property. It is not sufficient to enunciate a principle or suggest an idea, but there must be the practical embodiment of the principle and the development of the idea; in other words, the patentee must have discovered not only a principle, but a mode of carrying that principle into effect for a useful purpose, in which case he is entitled to a monopoly not only of that one

mode, but also of all other modes of carrying that principle into effect, in so far that no other person will be able to use them during the existence of his patent without his license. Nothing however forms proper subject-matter for letters patent which does not come fairly within the description of a "*new manufacture*;" and although this term possesses a very wide import and signification, yet it is sufficiently restrictive to exclude everything which does not fall under the category of a machine, a mechanical or chemical process, or a product or material, the result of such processes.

It follows, therefore, that a valid patent cannot be obtained for mental processes, such as new systems of calculation and the like, or for the discovery of natural products available for any particular purpose, unless there is employed, in conjunction with the system, some new apparatus by which it is carried out, or unless the exercise of inventive talent is involved in the mode of using the product.

With these exceptions, no useful invention is, abstractedly considered, unpatentable if it possess the requisite novelty; for although a common, and sometimes fatal, objection to a patent is that the alleged invention is an obvious suggestion, or the result merely of ordinary skill in design or construction, and not of inventive talent, yet such an objection paraphrased simply means that something so similar had been previously proposed that there was no real *novelty* in the suggested improvement. Hence *novelty*, after all, is the grand criterion by which to try the question whether or not such a supposed invention forms proper subject-matter for letters patent.

IV. NOVELTY.

This brings us to the consideration of the question of *novelty*, upon which we have already somewhat anticipated ourselves in the foregoing remarks.

An invention is deemed to be new if it is not publicly known in the United Kingdom. The deposit of a copy of the specification of a foreign patent for the same invention in a public library in the United Kingdom will invalidate a British patent subsequently obtained.

It is not sufficient, however, to prove that something analogous had been vaguely suggested previously, as the prior publication must be so full and complete, that any competent person might at its date have arrived at the same result as the patentee by simply following the directions given therein, without the aid of the additional light due to a present more advanced state of knowledge; although it sometimes happens that a prior publication which does not invalidate a patent operates to limit the range and extent of the claims under the same. Neither is it sufficient to show that some abortive attempt had been made to arrive at the same result in a similar way, as many patents have been supported under such circumstances, where it has been proved that the invention, although bearing an apparent resemblance to something which had preceded it, had proved practically successful, whereas its antecedent had signally failed, and the use thereof had been accordingly abandoned.

A prior public user, however, of substantially the same thing is fatal to a patent, *public user* being understood to mean *use in public*, and the term *user* including in its signification not merely *selling*, but *manufacturing for sale* and *offering for sale*. An experiment, however, by the inventor, conducted with ordinary care and precautions as to secrecy, is not considered as a public user, but it is always desirable to obtain protection for the invention before commencing public experiments, as otherwise the inventor runs great risk of being forestalled.

V. UTILITY.

Although it is as essential that an invention should be useful as that it should be novel in order to support a patent, yet a very small amount of utility will be sufficient to satisfy a judicial tribunal. If *some* advantage is obtained either in respect of economy, simplicity, facility, or any other quality, the patent will not be upset on the ground of want of utility; and even if it should appear that some *immaterial* part of a process or machine used in carrying out an invention is not useful, the patent will not be affected provided the *essential* parts possess some utility.

(*To be continued.*)

THE BARROW GAS MANAGER ON ELECTRIC AND GAS LIGHTING.

WE extract the following items from the manager's report on the Crystal Palace Electrical Exhibition:—

There are fourteen exhibitors, each claiming a distinct system, but in reality there are only two systems of electric lighting: one is illumination by the electric arc, and the other is illumination by the incandescence of a filament of carbon in vacuo; and the only practical difference in the various exhibits of the arc system of lighting is in the mechanism of the lamp used, and in the incandescent system the difference is in the form given to the carbon and in the method of attaching conducting wires to an exhausted globe. Of the two systems the arc light, if perfect (that is, steady and continuous), would be most suitable for the illumination of streets and large open spaces, on account of economy in production and brilliancy; but amongst the various examples (ten or eleven in number) of arc lamps exhibited, there is not one that can be called perfect, or nearly perfect, the sputtering and flickering, followed by occasional extinction, being as noticeable now as it was two or three years ago: the constant flickering is distressing to the eyes, and the occasional extinction in a crowded thoroughfare must be highly dangerous. The ever-varying intensity of the light and the liability to instant extinction may, in time, be overcome, and a tolerably steady light obtained, but until that is done, and there does not appear to be any immediate prospect of it, the light cannot be recommended for any purpose. But independent of the want of reliability, the question of cost of production is at present fatal to the general adoption of any system of electric lighting. The gas burners and lanterns used in London are similar to the large lanterns recently fixed in Barrow. An idea of the enormous expense incurred in the production of electric light may be obtained by observing the space occupied in the exhibition by the endless rows of steam boilers and engines, gas engines, and dynamo machines, and one-fourth of the floor space of the Palace being required for the machinery necessary to light the remaining three-fourths. On an equal space a gasworks could be erected to supply a town of 10,000 inhabitants. The incandescent light in common with the arc light is liable to instant extinction should the slightest hitch occur in any portion of the machinery employed in producing the electric current, and it will continue to be subject to this risk until means are discovered by which the electrical energy can be stored and drawn upon as required. It is the absence of a reserve or stock to draw upon that constitutes the chief difficulty (outside that of cost) the advocates of electric lighting have to meet. It is thought the "Faure" accumulator, in conjunction with the incandescent system, may be found to overcome the difficulty; but if so it can only be at a very considerable addition to the cost of the light, which already is fully ten times the cost of an equal quantity of light from gas. It is the general and confident opinion of electricians engaged on the lighting question, that a thoroughly reliable light will ultimately be produced, but they are not sanguine as to any considerable reduction in cost; on the other hand, great improvements continue to be made in high-power gas burners and lanterns. Experiments are in progress with a burner that will give from seventy to eighty per cent. more light per foot of gas consumed than it was possible to obtain from the best class of burner in use two years ago. Until a steady and continuous light can be obtained, and the cost of production has been considerably reduced, I cannot recommend the adoption of any system of electric lighting in substitution of gas.

It is but rarely that we come across such a one-sided and distorted report as the above even from the opponents of electric-lighting, and we would certainly advise the Barrow Corporation Gas and Water Committee to send delegates from amongst their own body to investigate the truth of the manager's criticism. We emphatically deny that the sputtering, flickering, and occasional extinction, is as noticeable now as it was two or three years ago, and we could point out several systems where these defects have been reduced to a minimum, and in the case of one particular arc lamp, which we have commented on very favourably at various times, the manager of the Barrow Gas Company would have his powers of perception severely tried to detect a flicker. In regard to occasional extinction we know of several instances where gas has been the culprit. Has this critic on electric lighting ever stood in the street to watch a gas jet? In London, at any rate, the flickering effect of ordinary gas jets is far more painful than anything we have experienced in street lighting by electricity. His remarks on the space occupied by the various machines and engines is simply ridiculous, they being there simply for exhibition and not to economise space. We were not aware until we had perused this egotistical report that lighting by means of incandescent lamps cost ten times as much as gas. We have used gas, which would have given us a certain amount of light, in an engine for motive power, and by thus converting the energy contained in the gas into electrical work, we have obtained considerably more light than the gas could have given us if used direct. The whole tone of the report is

most unfair, biassed, and incorrect; but we do not imagine that the ideas of other gas companies on this subject will be in any way altered on reading it, as the real facts are getting too well known for a report of such a character to produce any impression.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

The appointment of jurymen to pronounce an opinion upon the comparative merits of the Electrical Exhibition at Sydenham (Crystal Palace) does not appear to have met with that cordial approval and unanimity of appreciation amongst all our friends which might have been desirable. The directors of the Crystal Palace cannot please everybody, and we do not intend to express our own opinion as to what men such a jury should be composed of; but there can be no harm in repeating some of the murmurs which reach our ears as to those who should have been avoided. Glancing over the list of names which we gave in our last, it must be evident that there are many gentlemen upon this jury who are eminently qualified for the post. There appears to have been very little complimentary padding, the majority of the jurors being more or less connected with electrical pursuits. But the question which is asked by some of the exhibitors is, whether the fact of several of these gentlemen being either financially or professionally interested in individual exhibits should not have been considered as disqualifying them from serving on this jury. If we remember rightly, the names of Sir Samuel Canning, Mr. Shelford Bidwell, Professor Silvanus Thompson, Professor Ayrton, and some others have been advertised as being officially identified with the interests of different exhibits. These gentlemen are unimpeachable in every way as far as ability goes; but it may be fairly asked whether their judgment may not be open to be questioned on the score of bias—unintentional, but quite natural.

Professor Hughes' pretty induction balance is one of the most interesting amongst the exhibits, so is Mr. Spagnoletti's fire-alarm system; but does this fact not disqualify Professor Hughes and Mr. Spagnoletti for being unbiassed jurors? Perhaps not. The object of the selection may have been to insure on the jury an adequate comprehension or a fair advocacy of the different rival exhibits. If so, we are not sure that the plan is a satisfactory one, even assuming that the disinterested jurors were also indifferent and would not go into the details of the various exhibits *con amore*, or trouble to qualify themselves for expressing an authoritative verdict. Such a system, to be consistently followed out, would have necessitated the appointment of a representative juror for each of the exhibitors, otherwise those exhibitors who are not personally represented upon the jury may suspect that they are slightly at the mercy of their more fortunate rivals. We confess that we should have preferred to see the jurors, one and all, equally free from suspicion of any bias through business associations with any of the exhibitors whose systems they will have to judge, not only on account of the general body of exhibitors, but also having regard to the self-respect of the jurors themselves.

We have previously made remarks upon the conduct of this exhibition when we thought that in the interests of the exhibitor they were called for; and we have been told that as the Crystal Palace Exhibition is a private speculation, we had no more right to criticise its internal administrative arrangements than those of a shop. This is not a parallel case, because the public has been invited to believe that it will be in some way or other greatly benefited by this show; and as one of the public we have a right to an opinion. The Crystal Palace Exhibition may or may not have been got up for certain promotion purposes; that is not our affair; but, even then, criticism if fair cannot be unwholesome, and may be useful. Suppose a shopkeeper were to exhibit in his window the ticketed wares of the different rival manufacturers who supply him, with a view to awarding a measure of comparative praise or otherwise, professing the ultimate object of such exhibition to be the gain of the buyers, he would surely not appoint as judges of comparative excellence the commercial travellers of two other manufacturers themselves, for if he did so it is scarcely probable that either the other manufacturers or the buyers would be very confident as to the *bona fides* of the speculation. Is not the Crystal Palace jury a mistake altogether? Would it not have been better to leave the press and the public to make their own criticisms, and draw their own conclusions of the respective merits of those exhibitors who have gone to great trouble and expense to aid in drawing visitors to the Crystal Palace, rather than that the directors should take any part in the invidious and unnecessary task of comparisons?

THE GREAT WESTERN ELECTRIC LIGHT AND POWER COMPANY, LIMITED,

Is the title of a company, the propectus of which has been issued during the last week. The capital is stated at £250,000. First issue £125,000 in 25,000 ordinary shares of £5, of which 3,000 shares will be issued as fully paid-up to the vendors. The directors are:—Henry Maudslay, Esq., Hill-house, Bramerton, and Westminster Palace Hotel, S.W., Member of the Institutions of Civil and Mechanical Engineers; William Ladd, Esq., F.R.A.S., Electrician, London, Director of the Anglo-American Brush Electric Light Corporation, Limited; James Whitehead, Esq., Director of Pawson and Company, Limited, Highfield-house, Catford Bridge; Captain the Hon. Fulke Greville, Brooks' Club, and the Glen, Sunninghill, Berks; E. G. Clarke, Esq. (Messrs. Tribe, Clarke and Co.), 2, Moorgate Street Buildings, E.C., and Bristol (will join after allotment); J. Wesley Gardner, Esq. (Messrs. Gardner, Thomas and Co.), Bristol; H. Russell Evans, Esq., J.P., Newport, Monmouthshire; R. W. Southern, Esq., Mining Engineer, Cardiff. Bankers—National Provincial Bank of England, Limited, London; Bristol and West of England Bank, Limited, Bristol, and their several branches. Brokers—J. and A. Scrimgeour, 18, Old Broad Street, E.C. Solicitors—Clarke, Woodcock, and Ryland, 14, Lincoln's-inn-fields, London, W.C.; Fussell, Prichard, Swann, and Henderson, Liverpool-chambers, Bristol. Auditors—Turquand, Youngs and Co., 41, Coleman Street, London, E.C. Consulting Electrician—Professor Silvanus P. Thompson, D.Sc., B.A., F.R.A.S., University College, Bristol. Secretary—John Parsons. Temporary offices—31, Lombard Street, London, E.C., and 16, High Street, Bristol.

The prospectus in continuation says:—

This company is formed for the purpose of supplying the great and rapidly increasing demand for electricity in its various applications to light, motive power, and its numerous appliances; and for manufacturing and dealing in all articles in any way connected with the practical requirements of electrical science. It has secured the concession which has been granted by the Anglo-American Brush Electric Light Corporation, Limited, under which the exclusive right of use or sale of their dynamo machines and arc lamps, together with a licence for exclusive rights of use or sale of the Lane-Fox incandescent lamp, is secured for the counties of Gloucester, Somerset, Devon, Cornwall, Dorset, Wilts, Monmouth, Glamorgan, Pembroke, Carmarthen, Radnor, Brecon, and Hereford. . . . .

So far good. Then follow statements as to how the company is to make its profits, and afterwards come the annexed statements, the first of which is not over modest, but we give it for what it is worth:—

The Brush system of electric lighting is acknowledged to be the best, not only from the brilliancy, steadiness, and uniformity of the light, but from its great economy. Under the Brush system any number of arc lamps from 1 to 40, each of 2,000 candle-power, or any number from 1 to 12, each of 6,000 candle-power, or a single light of 50,000, or more candle-power, can be produced from a single dynamo machine, the connecting wires being extended over circuits of many miles, thus from one centre a large district can be economically lighted.

For domestic lighting the "Lane-Fox" system of incandescent lamps has given excellent results; from 18 to 100 lamps can be worked from one Brush dynamo, every lamp being capable of acting separately without affecting the others.

By the last Government report of the South Kensington Museum it appears that, with an outlay of less than £1,000 for machinery and plant for 16 "Brush" arc lights of 2,000 nominal candle-power each, after deducting all expenses, coal and wages, the saving over gas for the nine months has been at the rate of £425 16s. 4d. per annum, an ample margin of profit to cover interest and wear of machinery.

That portion referring to the Lane-Fox lamp has brought

forth a letter to the *Times* from the secretary of the Edison Electric Light Company, which reads thus :—

London, E.C., *April 1st.*

SIR,—Observing in your money article of to-day notice of the formation of a company called the Great Western Electric Light and Power Company (Limited), with "a licence for exclusive rights of use or sale of the Lane-Fox incandescent lamp for a number of counties in Wales and the West of England," I am instructed by the Board of Directors of the Edison Electric Light Company (Limited) to inform you that the Lane-Fox incandescent lamp is a direct infringement of Mr. Edison's patents in this country.

I am, Sir, your obedient servant,
ARNOLD WHITE, *Secretary.*

To those who have watched the various patents taken out for incandescence electric lamps, both the paragraph relating to the Lane-Fox lamps and the letter from Mr. White are very amusing. So far as we know it would seem that the only patents relating to incandescence lamps worth much, are those which patent methods of carbonising the filaments for them, the right to use carbon in a vacuum is, so far as we are aware, public property.

On the following morning to that on which the above letter appeared, the *Times* contained a reply signed by Mr. W. J. Cordner, the secretary to the Anglo-American Brush Electric Light Corporation, which concluded thus :—

The notice in the *Times* is the first notice my directors or Mr. Lane-Fox have received of the alleged infringement, and they both deny that such infringement exists.

It seems to my directors a matter of very questionable taste for Mr. Edison, or those who are financially interested in his patents, to seize the opportunity of making a statement of the positive character of a judicial decision at a time when the Great Western Electric Light and Power Company's (Limited) prospectus is in the papers, and when it is notorious that the Edison interests are likewise endeavouring to raise capital in this market.

We have instructed our solicitors to inform the Edison Company that we hold them liable for any damages we may sustain in consequence of the libel contained in the letter, and in conclusion we must ask you to courteously give this letter the same publicity you afforded to the letter of the Edison Company.

Then appears another letter which, we doubt not, will make most of our readers smile, and which we may possibly again refer to in another place. After a preliminary reference to the letters above mentioned, it continues thus :—

As the directors of the Edison Electric Light Company have thus called the attention of the public to an alleged infringement of patents belonging to them, we are instructed by our client, Mr. John Banting Rogers, to inform you that we have some days ago, on his behalf, given notice to the Edison Electric Light Company to the effect that the division of the light adopted in certain parts of their plant is an infringement of our client's patent for the division and subdivision of the electric current, and that legal proceedings with reference thereto are imminent.

We are, Sir, your obedient servants,
PEDLEY & BARTLETT.

However, to return to the prospectus under consideration; it also says that,

The invention of a perfect system of storage of electric energy, which is making rapid progress, will greatly enhance the value of the Brush patents, the Brush dynamo machine being considered the best for generating electricity, whether for working lamps distributed over large areas or for charging secondary batteries.

This is information, for we did not previously know that the Brush machine was the *best;* it is a good machine doubtless, but there are a great many now in the field, and the above praise savours, to say the least of it, somewhat of undue assertion. Mention is then made of the profits which have been secured by the Anglo-American Brush Electric Light Corporation of London, and also of the business done by Mr. Hammond, who has recently transferred it to a Limited Liability Company which bears his name, and then indicates that,

The concession has been purchased for £27,750, payable £12,750 in cash, and £15,000 in fully paid-up shares by the vendors from the Anglo-American Brush Electric Light Corporation (Limited). It includes the sole right to use all the Brush and Lane-Fox patented machines, lamps, &c., and future improvements therein, and is transferred to this Company for the sum of £34,500, payable £19,500 in cash, and £15,000 in fully paid-up shares, which sum is inclusive of all preliminary, formation, and other expenses of the Company, up to and including the date of allotment.

The profits of this Company will be derived from the special discount of 20 per cent. allowed by the Brush Company on machines and lamps supplied by them; also from contracts for lighting streets, factories, railways, hotels, collieries, public and private buildings, harbours, docks, ships, &c., and from the granting of sub-licences for local lighting companies throughout the thirteen counties comprised in the concession, and from the manufacture, purchase, sale, and hire of all or any articles or power in any way connected with electricity, together with the application of electricity as a motive power and other future developments.

That the Brush machines and lamps are good is sufficiently well proved, also that the directors of the parent company, and the manager of the Hammond, have made a good thing of electric lighting so far, is also doubtless without refutation. It is, however, desirable that *investors* should judge carefully as to the value of the patents in which they are investing. It by no means follows that because the parent company made a considerable sum of money on its first years' work that the offspring will likewise do so. Even the right to use the system of storage alluded to above, if it proves of value, will have to be purchased, although on first reading it may appear to some, to be a part of the property acquired by the payment of the £27,750 mentioned in the concession. To sum up, we think the prospectus altogether is not well drawn up. It appears overcoloured, and this, we fancy, was not necessary, and at all times is to be deprecated.

The counties of Western England and of Wales, as in other places, will probably be under the necessity of having the electric light introduced, and will, therefore, be good fields for the operations of such a company as that now promoted. We wish it a due measure of success.

CORRESPONDENCE.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Correspondence should arrive not later than Tuesday morning if it is desired to appear in the following number.

ELECTRIC LIGHTING FOR STREETS.

To the Editor of THE ELECTRICAL REVIEW.

DEAR SIR,—In reference to the article in your issue of March 25th, it seems only fair to point out, firstly, that our tender was for twenty arc lights, the largest number estimated for; and, secondly, that it included underground wires and all carriage and fixing; while in two of the other tenders overhead wires were specified, and in a third the cost of packing, carriage, and installation is not stated.

Yours faithfully,
REGINALD BROUGHAM,
British Electric Light Co., Limited, Engineer.
Heddon St., Regent St., W.
March 29th, 1882.

ELECTRICAL UNITS.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—It is not my habit to notice anonymous reviewers, but as Mr. T. P. Barkas courteously invites me to explain that which is not clear to him in his reading of my Elementary Lessons in Electricity and Magnetism, I have great pleasure in replying to his letter.

In the first place I must beg him to remember that the names of some of the Electrical Units were changed by the Paris Congress whilst my book was passing through the press. In the new edition now printing he will find the "ampère" substituted for the "weber" as the name of the unit of current, and the "coulomb" as that of the unit of quantity. The difficulty and confusion which beginners experience when they attempt to use the terms "ohm" and "volt," do not arise so much from any difficulty or doubt about the names themselves as from a want of knowledge of the very things which such terms are needed to specify. There should be no confusion between them, as each name refers only to quantities of its own kind, the "volt" to specify electromotive forces, the "ohm" resistances, and the

"ampère" the strength of currents. To use them interchangeably would be as absurd as to mix "pounds" and "inches" together. The expression "an electromotive force of 1·5 ampères" has no more meaning than the expression "a heavy weight of 1·5 miles" would have. You cannot specify an electromotive force in "ampères" any more than you can specify the weight of a mass in "miles."

Mr. Barkas says he "heartily agrees" with the reviewer of my lessons "when he criticises somewhat adversely the explanations given . . . . of the value of the ohm in relation to absolute units." I have looked through the anonymous review to which Mr. Barkas refers, and can find no allusion to the ohm or its relation with the "absolute units," so I am afraid I cannot gratify Mr. Barkas with a reply on a criticism which does not yet exist.

With one of the criticisms I hope Mr. Barkas does not, for his own sake, agree. My reviewer calls me to task for stating that "a unit magnetic pole is one of such a strength that when placed at a distance of one centimetre from a similar pole it repels it with a force of one dyne." [My reviewer says "one *degree*" (!) but I am not too uncharitable to believe this to be the printer's slip,] and he tells me that the reader should have been informed instead "that it is a strength that will support a certain weight." I am quite certain that my reviewer cannot himself tell what weight a pole of unit strength will support; and, moreover, the very suggestion reveals how lamentably ignorant of scientific terms he must be. Suppose I were writing a book for school boys on arithmetic, and by way of explaining how much a "gallon" is, were to write "a gallon of water is as much water as will weigh ten pounds" (which is indeed the explanation of how our wise men arrived at the 277·274 cubic inches that are often defined as "one gallon") and suppose further that some long-eared reviewer were to say that this explanation left the inquirer as much in the dark as before as to how much a gallon was, and that the reader ought to have been told that the proper definition of a gallon should have been the amount of beer that a drayman can "support" without becoming quarrelsome, what would you think of the reviewer or of his competence to write on the question? But the fact is that the standard magnetic unit is just as strictly fixed and defined by the electrical authorities, the committee of the British Association, and the International Paris Congress, as the standard gallon is by the British Parliament; and it would be not only absurd, but useless, for an electrician to set up another unit of his own; especially such an impracticable one as that proposed by the anonymous reviewer.

In my book (page 85), I expressly state what my reviewer cannot deny without denying the authority that has laid down the accepted definitions of units, that instead of measuring the strength of a magnet by its "lifting power" (which depends not on its strength only but on its shape and length, and on the shape and material of the mass it lifts), "the strength of a magnet pole must be measured by the magnetic force which it exerts" on another magnet, and in the last sentence on that very page I have given a simple numerical example; one so simple, indeed, that my reviewer appears not to have considered it a numerical example at all. It is as follows: *Thus, suppose there are two magnets,* A *and* B, *whose strengths we compare by making them each act upon the North pole of a third magnet,* C: *if the North pole of* A *repels* C *with twice as much force as that with which the North pole of* B *placed at the same distance would repel* C, *then we should say that the "strength" of* A *was twice that of* B." To confound the "strength" of the pole with the "lifting-power" of the magnet shows how very little accurate knowledge the author of the criticism has at his disposal.

But before I conclude I will enter my thanks to Mr. Barkas, and assure him that hints as to points on which explanation is required by readers not versed in technical matters are always of value to those who write for the public; for it is obviously to their interest to write what the public wants to know. I hope before long to write a plain, unvarnished tale, which may afford the explanations desired concerning the accepted units. It is impossible in a small text-book for general use to introduce lengthy explanations on every point on which some one reader might fail to see the meaning or usefulness of the various usages adopted in the science. I don't think that any ordinary book on arithmetic goes out of its way to afford detailed explanations why the British "yard" is taken of a particular length; why a "gallon" is fixed to contain a certain number of cubic inches; or why we give the name of one "hour" to the twenty-fourth part of "one day." But this is the kind of information that would be analogous to that asked for by Mr. Barkas in the case of electrical units. The electrician who is asked to explain without using technical terms how strong a magnet of unit strength is, is very much in the position of a traveller who is asked by a native in the middle of Africa how cold one degree below zero is. We comprehend "yards," "gallons," "hours," "degrees of temperature," &c., not because any one has elaborately explained their origin to us, but because we have had practice in using and applying these terms. And so in the case of "centimetres," "grammes," "dynes," and "ergs;" and also in the case of "volts," "ohms," "ampères," and "coulombs"; practice in using and applying them brings home their significance, and makes us comprehend their meaning in a way that no amount of detailed explanation can ever do.

SILVANUS P. THOMPSON.

University College, Bristol,
April, 1882.

[We insert this communication from Prof. Silvanus Thompson, although he makes the letter of Mr. Barkas a pretext for the most unusual course of criticising a Review, but at the same time we must express our regret that he should have so far forgotten his usual courtesy as to use offensive epithets. Our Reviewer will probably reply to the scientific portion of Prof. Thompson's remarks in our next. We may remark that it is not usual for the writer of a review to attach his signature to the same, although we believe Prof. Thompson invariably does so himself. We are obliged to Professor Thompson for calling our attention to the misprint to which he refers, but which, however, it is almost needless to say, was obviously a printer's error.—Ed. Elec. Rev.]

LEGISLATION FOR CABLE PROPERTY.

To the Editor of The Electrical Review.

Sir,—I enclose you copy of a Bill draughted by me, which was introduced in January, 1871, in the Senate of the Congress of the United States, which received a first and second reading, and was referred to the Senate Committee on Foreign Relations, of which Mr. Sumner, of Massachusetts, was chairman. The Bill was reported back to the Senate, but failed to be brought to a vote in consequence of the early adjournment of Congress on March 4th, 1871:—

"Section 1. Be it enacted that any person or persons on board any vessel registered in the United States, and sailing under the flag of the United States, who shall knowingly injure or destroy any cable used for the transmission of messages, submerged under the high seas, shall upon conviction thereof in any United States court, be imprisoned for a term of not less than one year nor more than five years, in the discretion of the presiding judge or judges.

"Section 2. Be it further enacted that any citizen or citizens of the United States on board any vessel sailing under the flag of any foreign nation who shall knowingly injure or destroy any cable used for the transmission of messages submerged under the high seas, shall, upon conviction thereof in any United States court, be imprisoned for a term of not less than one year nor more than five years, in the discretion of the presiding judge or judges.

Section 3. Be it further enacted that the owner or owners of any cable used for the transmission of messages submerged under the high seas, shall have the right to bring a suit for damages, in the District Court of the United States for the district in which is registered any vessel on board of which any person or persons shall have injured or destroyed any such cable, against the owner or owners of any such vessel, or against the vessel."

Other sections declared "the knowingly injuring or destroying such cable" to be a criminal offence, and instructed the proper law officers to take the usual proceedings to punish the offenders.

Would not the enactment of a similar law by all countries be an efficient protection for cable property, and much more expeditious than the long process by international treaties?

I will add that the senator who introduced this bill ceased to be a senator on March 4th, 1871, and the promoter left the United States shortly afterwards, and no one has taken any measures since to have the bill introduced.

Yours, &c.,

W. C. B.

THE ACTION OF THE TELEPHONE.

To the Editor of THE ELECTRICAL REVIEW.

SIR,—With reference to Mr. Strangways' query as to how to "send through the primary coil a current whose strength continually and uniformly diminishes or increases," and "which is clearly, unmistakably, and indisputably that which Bell describes as an undulatory current, and not a mere series of impulses," Mr. Strangways has only to insert in the primary circuit of the induction coil a Jacobi's rheostat, with fine platinum wire on it, and he will have the means of effecting the continual variation of the current. By turning the cylinder of the rheostat rapidly the resistance in the circuit will be increased or diminished rapidly, and by turning it slowly the resistance will be varied slowly. If the secondary coil is connected to a sensitive galvanometer, a *permanent* deflection will be obtained, which will vary in degree according as the rheostat cylinder is rotated fast or slow; and the direction of the deflection will vary according as the rotation of the cylinder produces an increase or a decrease in the current. Mr. Strangways says in his last letter: "I have carefully watched the effect of the current of a Bell telephone, used as a generator, in a very sensitive reflecting galvanometer, and, in my judgment, the effect on the galvanometer is produced by a series of impulses, and there is not a continuous current." By this I presume the writer argues that the movement of the diaphragm, either towards or away from the pole of the permanent magnet, produces only a so-called momentary current. Suppose now we make the following well-known laboratory experiment: take a straight bar electro-magnet and connect it to a sensitive galvanometer; now approach a powerful permanent magnet towards the end of the iron core, and the result will be that we shall get a deflection of the galvanometer needle; if we next make the magnet recede from the iron core we shall get a deflection in the opposite direction. Now, if the currents causing the deflections are only momentary, I would ask at what moment do they commence to circulate according to Mr. Strangways? Suppose the permanent magnet is at starting at a distance of 4 inches from the end of the core, and when it is brought close it is at a distance of $\frac{1}{8}$th of an inch, does the current circulate only at the moment when the magnet reaches its minimum distance from the pole, or at the commencement of its movement from the distance of 4 inches, or at some intermediate point? If Mr. Strangways will make this experiment he will find that the needle of the galvanometer commences to move when the permanent magnet commences to approach the iron core, and will deflect more and more as the magnet approaches nearer, the limit being reached when the magnet is closest to the core; moreover, if a Bain recorder be placed in the circuit *a continuous line* will be found traced out on the paper slip, and not a mere dot simply. Substitute a permanent magnet for the iron core, and a diaphragm for the movable permanent magnet, and we have the condition of affairs in a Bell receiver.

With regard to the second paragraph in Mr. Strangways' letter, the answer is this:—In a break such as takes place in a Reiss transmitter there is a change in the current from, say, 10 milliampères (when the circuit is closed) to 0 milliampères (when the circuit is open). There is no period at which a current of, say, 5 milliampères flows; in the undulatory current the strength commences at 10 ampères, and falls down gradually to 0 milliampères, there being periods at which every strength of current intermediate in value between 10 and 0 ampères exists. Suppose we have the diaphragm of a Reiss transmitter transmitting a note which is produced by 100 vibrations a second, then when the two platinum surfaces are in contact we have a current of, say, 10 milliampères flowing. This current lasts for $\frac{1}{200}$th of a second; a break now takes place, and the current becomes zero. The period during which this cessation lasts is also $\frac{1}{200}$th of a second. Contact is now again made, and the current of 10 milliampères again flows, and so on.

In the case of the microphone the action is as follows:—at first a current of 10 milliampères flows, the pressure of contact now varies so that at, say, $\frac{1}{5}$th of the $\frac{1}{200}$th of a second the current has fallen to 9 milliampères, at $\frac{2}{5}$ths of the $\frac{1}{200}$th of a second it has fallen to 8 milliampères, at $\frac{3}{5}$ths of $\frac{1}{200}$th, that is, at the end of $\frac{1}{200}$th of a second, the current is 5 milliampères; the pressure of contact now varies the other way, so that the current runs up by uniform stages (not *steps*) up to 10 milliampères again, and so on. In the example I have taken I have supposed the increase or decrease of current to have taken place uniformly, *i.e.*, if the times and corresponding currents were plotted out graphically, the points when joined would form a straight line; but the currents corresponding to any particular period might be such that the results plotted out form a *curve*, and not a straight line; it is the form of this curve that determines the *timbre* or quality of a tone; this it is obvious must be entirely absent in a simple make-and-break arrangement. Again, in the case of the make and break, the changes that take place in the current are changes from 10 milliampères to 0 milliampères, or a difference of 10 — 0 = 10; in the case of the microphone we have supposed the variation to take place from 10 to 5, or a difference of 10 — 5 = 5, in other words the *loudness* of the sound in the latter case would be only half as great as it is in the case of the make and break, but it might happen that the change is from 10 to 8 ampères only, in which case the sound would be less loud still. Here, then, we have variation of *loudness* which is the third characteristic of sounds; this characteristic in the make-and-break arrangement is fixed and invariable.

My argument, to which Mr. Strangways refers at the end of his letter, was perhaps not a perfect one, nor was it meant to be an exact parallel to the exact state of the case; but I simply wished to point out that Mr. Strangways argued that because the make-and-break arrangement was able to produce *one* of the *three* characteristics of articulate speech, viz., "pitch," that therefore it could produce them all. Referring again to Mr. Strangways' first letter, in which he brings forward as an argument for the make-and-break theory the fact that Reiss's transmitter will produce articulate speech, as your leader of the 4th ult. clearly points out, this articulate speech is only produced when the make-and-break action does not take place.

Yours faithfully,

April 3rd. TELEPHONE.

NOTES.

THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS.—The next meeting will take place at 25, Great George Street, S.W., at 8 p.m., on Thursday, April 13th, when papers will be read as follows:—"Description of a form of Battery of Low Internal Resistance," by F. Higgins, member; "Tests of Incandescent Lamps, with special reference to the decrease in Resistance of the Carbon with an increase of Electromotive Force," by Andrew Jamieson, member.

ROYAL SOCIETY OF EDINBURGH.—At the ninth ordinary meeting of the Royal Society of Edinburgh, held on Monday evening last, a paper by Prof. C. M. Smith, on "Atmospheric Electricity," was communicated by Prof. Tait. Prof. Chrystal afterwards read a paper by Mr. A. Jamieson, Glasgow, giving the results of recent tests of Swan's lamp for fall of resistance with increase of electromotive force and ratio of candle-power to work expended. In the course of the discussion which followed, Sir William Thomson, alluding to the importance of ascertaining how long a lamp would last at a certain power, pointed out that slight inequalities in the fibre used in these lamps constituted the evil which caused one lamp to break down at one point, and another at another point. Two important matters to be determined were the quality of the carbon and the uniformity of the film from end to end. Several other communications were laid on the table.

LECTURE ON ELECTRIC-LIGHTING.—We believe that Mr. Alexander Siemens delivered a lecture, last Wednesday evening, at the Crystal Palace, on "The Production and Distribution of Electrical Energy for Lighting and other purposes, according to the system of Siemens Bros."

THE TELEPHONE AND FIRE-ALARMS AT BRIGHTON.—The Watch Committee of the Town Council have accepted

an offer by Mr. Volk, of Brighton, to place his fire alarms in the Royal Pavilion, and to connect the same with the Police-station at the Town Hall, and, on behalf of the United Telephone Company, to connect the Town Hall, the Pavilion, and the Volunteer Fire Brigade Station by telephone, on condition that the wires are carried underground, and that all expenses are paid by Mr. Volk and the Telephone Company.

The Central and South American Company's Cables.—On Monday morning last, Mr. Robert K. Gray, the Engineer-in-Chief of the Silvertown India Rubber and Gutta Percha Works Company, left London for Southampton, sailing thence the same day per mail steamship *Moselle*, to join the steamship *Silvertown*, on the West Coast of Central America.

The West India and Panama Company.—Mr. C. M. Hooper, the Secretary of the above company, left England in the same steamer with Mr. Gray, *en route* for the West Indies, on an inspection trip to some of the company's stations there.

Privacy of Telegrams.—In the House of Commons on Monday last, Mr. Fawcett, replying to a question put by Mr. M. Scott with regard to the correspondence which had appeared in the public press as to the contents of a telegram addressed to Mr. T. Wright, the aeronaut, by Colonel Fred Burnaby, having been divulged by an official of the Submarine Telegraph Company to the President of the Balloon Society, said that, so far as his individual opinion was concerned, the contents of telegrams ought not to be disclosed, but the Post-office had no power in the matter of the telegram in question, because the Telegraph Acts of 1863 and 1868, while securing the secrecy of inland telegrams, did not apply to foreign ones sent through the Submarine and other foreign telegraph companies.

Telegraph Extensions.—On the evening of the 3rd inst. Mr. Round asked the Postmaster-General if he was able to make any announcement with reference to the amount of guarantee now required by the Treasury in cases of telegraph extension in rural districts. Mr. Fawcett said it would not be necessary in future to pay the guarantee beforehand, but only to make up any deficiency at the end of the year. That was a substantial concession. At the same time the new regulations might slightly increase the amount of the guarantees.

Secondary Batteries.—On the evening of Tuesday last the directors of the Electrical Power Storage Company entertained at dinner in the Crystal Palace a large number of gentlemen interested in electrical science, and afterwards exhibited the capabilities of the new secondary battery of Messrs. Sellon and Volckmar, in its application to incandescent electric lighting, in the Alhambra Court of the Palace. Want of space compels us to leave over that which we would otherwise like to say; but we may add that the battery more than confirmed the good impression it had already produced, and all those present, the majority being eminent men in the scientific world, took great interest in the proceedings. In our next we shall hope to enter more fully into the matter.

Telephonic Transmitters.—M. Salet has already published the description of several liquid telephonic transmitters, *i.e.*, of apparatus in which the oscillations of the vibrating plate cause a variation in the resistance of one portion of the circuit, which is liquid. He has given in the reports of the Academy his reasons for believing that these transmitters can reproduce the quality of sound more faithfully than Bell's electro-magnetic telephone.

M. Salet's first model utilised the variations in length of the electrolytic conductor obtained by making one of the electrodes vibrate. This is Graham Bell's method, but with this modification, that the oscillations of the electrode, being five times as great as those of the telephonic plate, gave much greater variations of intensity and more powerful sounds. The electrodes were very near together, and a metallic solution could not well be employed, as the deposit would soon have modified their distance. Acidulated water was therefore used, and the formation of bubbles caused an objectionable noise.

M. Salet then constructed a second telephone on a new principle. The electrodes were fixed, the liquid used was sulphate of copper, and the vibrations of the plate were utilised inclosing more or less the orifices of a kind of multiple slide-valve, working like those in steam-engines, and serving to put into communication two vessels filled with the metallic solution and furnished with electrodes. By this means he obtained variations of section in the conductor, and consequently variations of intensity. This telephone gave rather good results, but it was difficult to construct, and presented, even when the orifices were covered, a somewhat strong conductivity, owing to the layer of liquid which always existed between the slide-valve and its recess.

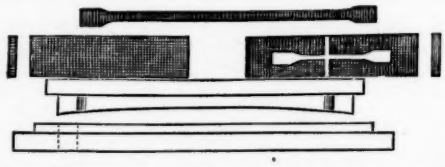
The following method, which figured at the Paris Electrical Exhibition, was then arrived at. A sheet of glass, arranged like the reed-stops in a musical instrument, was placed in direct contact with a rod coming from the centre of the vibrating plate, and vibrated with it.

The channel of this sheet formed the bottom of a cell containing the sulphate of copper and a copper electrode: this cell was immersed in a receiver containing the same liquid and the other electrode. As before, the displacements of the telephonic plate modified the section of the conductor and its resistance, only this resistance was very great (300 ohms on an average), and its variations very sensible. Whence resulted: (1) the possibility of producing a somewhat strong sound with few battery elements (5 cells Leclanché); (2) the lessening of the consumption of the battery; (3) and above all, the suppression of the induction coil for a line of less resistance than 40 kilometres. A button serves as a reversing interrupter. If turned in the direction of the hands of a watch it puts the apparatus in circuit; if turned in the opposite direction, it interrupts the current; but if the first movement be repeated, it has the effect of re-establishing but reversing the current. Each electrode is therefore positive or negative by turns, and loses or gains in weight; in fact, it is not consumed. In a practical model since constructed, the vessels of sulphate of copper only contain 150 cubic centimetres of liquid; they are in the form of bottles; glycerine is added to the solution, and there is no need to mix water with it except for the batteries.

The Böttscher Telephone.—This is another new telephone, as remarkable for its simplicity as for the powerfulness of its effects. This apparatus dispenses with induction coils and batteries, and owing to an ingenious mechanical arrangement, the receiver is as sensible as if it were microphonic. The apparatus consists of a cylindrical copper box, fourteen centimetres in diameter and five centimetres in height, in which are placed the component parts, and which is closed by a lid with a hole in the middle. To this lid, at the right of the orifice, is fixed a mouthpiece for speaking into. The sounds emitted strike a vibrating plate screwed into the lid, the vibrations of which influence the magnetism of a magnet connected with the sides of the box by three steel wires, the tension of which can be regulated at will. The plan of the system can now be understood. The magnet is able, owing to the elasticity of the wires, to oscillate feebly in the direction of the vibrations of the plate when the latter approaches it, and as the magnetic action increases in proportion to the square of the distance, the amplitude of the vibration increases until the tension of the wires on the one hand and the elasticity of the plate on the other bring the attraction into equilibrium. On the contrary, as soon as the plate goes back the tension of the wires draws back the magnet, and the demagnetisation takes place much more rapidly. By this means, therefore, we succeed in increasing the variations of magnetism in the magnet, and consequently a wire wound round the poles of this magnet produce much more energetic induction currents. We have here then a portable telephone, giving most satisfactory results, not easily put out of order, and leaving far behind it the Gower system and other similar ones.—*Revue Scientifique*, Feb. 18th, 1882.

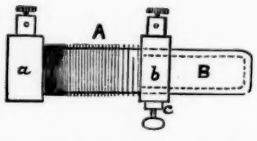
Carbon for Electric Lamps.—Patent No. 254,672. Filed in the United States of America Patent Office, April 25th, 1881. Hiram S. Maxim, Brooklyn, assignor to the United

States Electric Lighting Company, New York. (No specimens.)



Claim.—The process of manufacturing carbon conductors for incandescent lamps by first carbonising at a high temperature in a flask sheets of proper material, then cutting or punching from these the conductors in any desired shape, and lastly heating the said conductors in a carbonaceous gas or vapour, substantially as set forth and described.

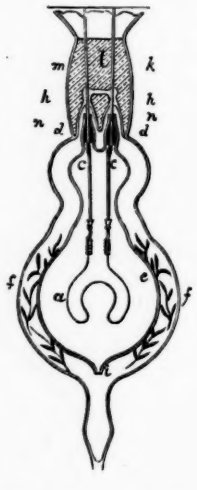
RHEOSTAT FOR ELECTRIC LAMPS.—Patent No. 254,764. Filed in the United States of America Patent Office, July 7th, 1881.—By P. H. FOX.



Claim.—1. The regulator for electric circuits, consisting of a loose coil, A, adjustable slide, *b*, and sustaining-rod, B, combined for operation substantially as shown and described.

2. The combination with the circuit-wires of an electric lamp, of the coil, A, fixed at one end, the slide, *b*, and the slide-rod, B, substantially as shown and described, for the purposes set forth.

ELECTRIC LAMP.—Patent No. 254,641. Filed in the United States of America Patent Office, Nov. 19th, 1881.—By J. H. Guest.



Claim.—1. In an electric lamp, the combination, with the incandescing filament and conducting-wires, of the glass, *e*, surrounding the filament, and the glass shade, *f*, around the glass, *e*, there being a vacuum in both the shade, *f*, and glass, *e*, substantially as set forth.

2. The combination, with the glass, *e*, tubes, *d*, incandescing filament, conducting-wires, and lead packing between the glass tubes and wires, of the outer ornamental glass shade, *f*, hermetically sealed at the conducting-wires, substantially as set forth.

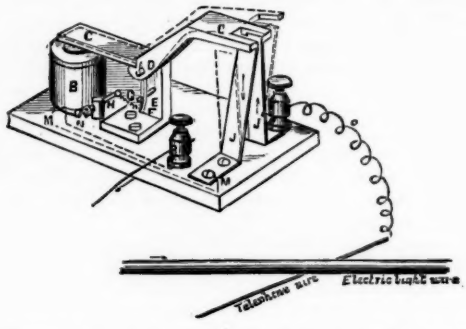
3. The combination, in an electric lamp, of the incandescing filament; its wires, the inner glass, *e*, the outer glass shade, *f*, the tubes, *h*, cap, *m*, and the plaster uniting the tubes, *h*, and shade, *f*, with the cap, *m*, substantially as set forth.

4. In combination with the conducting-wires, incandescing filament, and glass shade, a cap, *m*, a packing of fibrous material between the cap and the parts of the glass shade, and plaster within the cap, for the purposes and as set forth.

5. In combination with the tubes and hermetically-sealed wires in an incandescing electric lamp, the bridge of glass between said tubes, for the purposes and as substantially set forth.

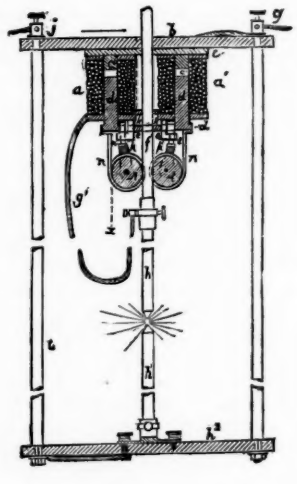
6. The semi-cylindrical clips for the carbon, made of flattened wire, and the twisted portion to hold the parts together, in combination with the carbon having thickened ends and the plating of metal upon the parts, as set forth.

SAFETY DEVICE FOR ELECTRIC WIRES. — Patent No. 254,099, filed in the United States of America Patent Office, Dec. 29th, 1881.—By S. E. Plush.



Claim.—The springs, J J′, in combination with the forked pivoted armature, C, and magnet, B, all forming parts of an electric circuit, and the spring, G, which resists said magnet, whereby a weak current of electricity is allowed to pass in said circuit for telephonic or other purposes, but a dangerously strong current causes the magnet, B, to overcome the resistance of spring, G, and draw one end of the armature down, so as to free said springs from the other end, and thereby break the current.

ELECTRIC LAMP.—Patent No. 254,005. Filed in the United States of America Patent Office, Nov. 29th, 1881.—By G. W. Sawyer.



Claim.—1. An electric-arc-lamp regulator composed of the following instrumentalities in combination: friction guide-pulleys embracing the upper-carbon-holding rod, and the moving core or armature of an electro-magnetic device provided with brake-arms adapted to prevent the rotation of the guide-pulleys and raise them with the carbon-holding rod clamped between them, when the core or armature is acted on by induction from the electric current passing through the coils of the electro-magnetic device, substantially as set forth.

2. In combination with the moving core or armature of an electro-magnet, the brake-arms, *n n*, pulleys, *l l*, fitted in vertically sliding bearings, and the carbon rod, *f*, substantially as and for the purpose hereinbefore set forth.

3. In combination, the rod, *f*, pulleys, *l l*, yokes, *k k*, having slotted necks, brackets, *e e*, having set-screws, *e′ e′*, and brake-arms, *n n*, connected to bar, *d′*, of the moving cores, *d d*, substantially as set forth.

4. The electro-magnetic device composed of the helices, *a a'*, fixed connected cores, *c' c'*, and movable connected cores, *d d*, in combination with the brake-arms, *n n*, pulleys, *l l*, yokes, *k k*, and carbon rod, *f*, substantially as set forth.

The Eastern Extension Australian and China Telegraph Company, Limited.—Including £27,350 received for government subsidies, the gross receipts of this company for the half-year ended with December 31st, amounted, according to the report just issued, to £205,963, against £193,435. Working and other incidental and current expenses having been provided for, there is an available balance of £146,165 after debenture interest has been met, and the previous half-year's undivided balance brought forward. Against that sum, however, the directors have charged £34,363 on account of the new Singapore-Batavia cable, which was successfully laid and opened for traffic in the latter part of November last. A further £30,000 connected with the cost of this new cable remains to be dealt with during the current year. An interim dividend of 1¼ per cent. was paid during the half-year, and a similar return is now proposed in addition to a bonus of 1s. per share, which, with two interim dividends and a bonus for the first half of the year, makes a total distribution of 6 per cent. for 1881. The balance of £51,876 has been carried to the reserve fund, which is now raised to £276,203.

NEW COMPANIES REGISTERED.

Great Western Electric Light and Power Company, Limited.—Capital £250,000, in £5 shares. Objects: To purchase the interests of John Parsons and Edward Gustavus Clarke, both of Bristol, in certain concessions or licences from the Anglo-American Brush Electric Light Corporation, Limited, authorising the use of their letters patent. The purchase consideration is £19,500 in cash and £15,000 in fully paid-up shares. Signatories (with 50 shares each): Wm. Ladd, 11, Beak Street; H. Maudsley, C.E., Westminster Palace Hotel, Victoria Street; H. Russell Evans, Newport, Monmouth; J. Wesley Gardner, Bristol; R. W. A. Southern, Cardiff; John Parsons, Bristol; and F. G. Painter, 2, Moorgate Street Buildings, E.C. Directing qualification: 50 ordinary shares or £250 stock. The first five signatories, and E. Gustavus Clarke, are the first directors. Remuneration: £1,000 per annum. Registered 30th ult. by Clarke & Co., Lincoln's Inn Fields.

Electric Fire Alarm and Signals Company, Limited.—Capital £100,000, in £1 shares. Objects: To erect, maintain, and work wires and apparatus whereby electric and other signals may be utilised as fire-alarms, or for calling messengers, cabs, policemen, and for other purposes. Two agreements dated 28th ult. will be adopted and carried into effect by the company; the first of these is between Edward Brailsford Bright and Robert Scott Walker, and the second between the Exchange Telegraph Company and Robert Scott Walker. Signatories (with one share each): Robert S. Walker, Upper Teddington; G. T. Hancock, 75, Blackheath Hill; E. D. White, 54, The Chase, Clapham Common; Wilfred C. King, 17, Cornhill; J. F. H. Woodward, 23, Elsham Road, Kensington; Weston Parry, 28, Queen Street, E.C.; John Gaskell, Bradford. The signatories are to appoint the first directors. Qualification: £250 in shares or stock. Remuneration: £150 per annum in respect of each director. Registered 31st ult. by Bompas, Bischoff and Dodgson, 4, Great Winchester Street, E.C.

Railway and Electric Appliances Company, Limited.—Capital £500,000, in £1 shares. Objects: To manufacture and supply electric light and power and similar agencies, and also to trade in railway, electric, telephonic, and other appliances. The company will enter into and carry out contracts with the Williams Railway Patents Company, Limited; the Electric Light and Power Generator Company, Limited; and the National Electric Company, Limited. Signatories (with one share each): Wm. Alexander Smith, J. A. Watson, P. T. Rottenburg, David Graham (electrical engineer), W. B. Smith, and W. C. Muir, all of Glasgow. Directing qualification: 500 shares. The subscribers are to nominate the first directors, and in the mean time are themselves to act as directors. Remuneration: £2,000 per annum. Registered 31st ult. by Hunnard & Co., 5, Middle Temple Lane.

NEW PATENTS—1882.

1516. "An improved manufacture of material for electrical insulation." J. Imbay. (Communicated by La Société Anonyme des Cables Electriques.) Dated March 29.

1526. "An improved method of, and apparatus for, transmitting and printing telegraphic messages." W. R. Lake. (Communicated by A. F. and F. B. Johnson.) Dated March 29.

1548. "Secondary batteries." W. B. Brain. Dated March 30.

1555. "Telephones." J. H. Johnson. (Communicated by C. G. Rodrigues-Pereire.) Dated March 30.

1556. "Generation, storage, distribution, regulation, and utilisation of electricity, and apparatus or means therefor." J. S. Williams. Dated March 30.

1570. "Electric arc lamps." W. Jeffrey. Dated March 31.

1574. "An improved method of, and apparatus for, augmenting or strengthening electric currents for telephonic purposes." W. R. Lake. (Communicated by J. Moser.) Dated March 31.

1580. "Electric lamps." Sir D. Salomons. Dated March 31.

1583. "An improved electric bell and electric battery." H. Binks. (Communicated by M. J. Siegel.) Dated April 1.

1587. "Secondary batteries." A. Tribe. Dated April 1.

1600. "Electrical apparatus for employment in the indicating and extinguishing of fires." G. W. Von Nawrocki. (Communicated by F. Bahr.) Dated April 1.

1611. "Improvements in electro-magnetic and regulating apparatus, chiefly designed for use in electric lamps." W. R. Lake. (Communicated by E. Weston.) Dated April 3.

1614. "Magneto or dynamo-electric machines." W. R. Lake. (Communicated by E. Weston.) Dated April 3.

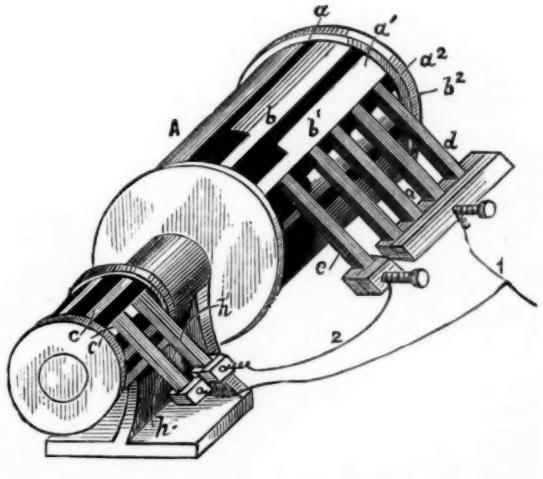
1616. "Mode of and machinery for the production of electric currents." W. B. Brain. Dated April 3.

1618. "Improved arrangement of incandescent or other electric lamp, to render it portable and capable of being fitted temporarily at any available place or position, and removable therefrom at will." J. B. Rogers. Dated April 3.

1619. "Improvements in the manufacture of carbon conductors or electrodes for electric lamps, and in apparatus therefor." W. R. Lake. (Communicated by H. S. Maxim.) Dated April 3.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

3231. "Commutators for dynamo- or magneto-electric machines, &c." E. G. Brewer. (A communication from abroad by Thomas Alva Edison.) Dated July 23. 6d. The object of this invention is to obtain means for reducing the sparks at the commutators of dynamo machines to the minimum. In carrying out this invention the insulation is widened and the conducting bars narrowed at one end of the commutator cylinder, and upon this portion of said cylinder, on each side thereof, a single commutator brush is arranged to bear, whose bearing end is noticeably behind the ends of the main brushes beside



which it is placed. This brush, which is termed for the purpose of distinction the "isolated" brush, is not connected with the main brushes directly, but is connected with a series of breaking points, resting on a "breaking cylinder," which breaking cylinder has conducting bars and insulating spaces corresponding with those upon which the "isolated brush" bears. This cylinder may be a separate cylinder mounted on the end of the shaft of the machine, or it can be a continuation of the commutator cylinder, its conducting bars being

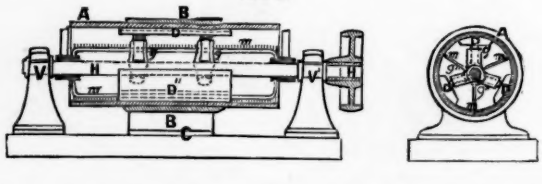
insulated from those of the commutator cylinder. In the working of the machine the local circuit and a portion of the main current are continued through each "isolated brush" after the main brushes have left each commutator bar, so that no spark is produced at the points of the main brushes. When each "isolated brush" leaves a commutator bar, the current passing through it is also broken at a number of points on the breaking cylinder, simultaneously with the breaking of the current on the commutator cylinder by the "isolated brush." The figure represents a commutator in which a separate breaking cylinder is used. In the figure, A is the commutator cylinder, a, a^1, a^2, being insulating, and b, b^1, b^2, conducting bars of its surface. The conducting bars are narrowed and the insulating spaces widened at the outer end of the cylinder. B is the breaking cylinder whose conducting bars, c, c^1, correspond to those at the outer end of the commutator cylinder. d, d, are the main commutator brushes which take off the current and convey it to the wire 1. e is the "isolated brush" connected by the wire 2 to the brushes, h, h^1, on the breaking cylinder. The conducting bars of the breaking cylinder are of such width that the brushes, h, h^1, break circuit simultaneously with the brush e.

3240. "Obtaining electric light, &c." T. E. GATEHOUSE. Dated July 25. 6d. Relates to a method of electric lighting by the incandescence of suitable material, and the regulation of the light giving substance by simple and novel means; also to the increasing the durability of the incandescent material. It is well known that the electrical resistance of metallic wires is increased by the application of heat, and on the other hand that a rod of carbon or graphite conducts better when hot. When a wire, as for instance platinum, is used alone for the purpose of producing an incandescent electric light, there is considerable risk of fusion upon any increase of current passing through. Regulators have been proposed to prevent this fusion, but without any practical success. The inventor proposes to take advantage of the foregoing and opposite properties of carbon and such like material and metallic wires, such as platinum, iridium, and other suitable metals or alloys, to produce an incandescent light, the carbon or like material acting as a regulator to the incandescent wire. According to one arrangement the light giving material is used in conjunction or combination with the carbon or such body in a parallel circuit, the two materials having their lengths and sections properly proportioned, and therefore also their respective resistances.

3369. "Working gear and appliances used in electric lighting." KILLINGWORTH W. HEDGES. Dated Aug. 3. 6d. One part of this invention relates to the construction of a switch or contact breaker in which a piece of metal is caused to slide laterally off and on to one or more metallic connections, so as to either break the circuit or change the direction of the current. The invention also relates to an improvement in the driving gear of machines for producing the electric light where it is desirable for the machine to be near the motor. For this purpose the wheel fixed on the driving shaft is pressed against the driven pulley of the machine as in the ordinary frictional gear, but in addition there is a third wheel or loose pulley upon a separate shaft, which is caused to press upon the opposite side of the driven pulley of the machine by encircling it with a strap which also goes partially round the driving wheel. The centre of the third wheel is not in line with the other two, but is capable of being moved nearer to such line, and by such movement the contact becomes more forcible and the strap is at the same time tightened or increased in tension.

3400. "Electric machines." J. H. JOHNSON. (A communication from abroad by Jean Baptiste Java Mignon and Stanislas Henri Rouart, both of Paris.) Dated August 5. 6d. Relates to improvements in electric machines or apparatus for generating electricity, whereby great economy and simplicity of construction are obtained. The improved electrical machine with stationary collecting elements illustrated by the fig. is constructed by the application of modern mechanical principles to the electrical machine usually employed in the study of physical phenomena. The said apparatus consists essentially of a cylinder, A, constructed of non-conducting materials, such as glass, hardened india-rubber, wood, and the like. This cylinder is stationary, and is inclosed except at its extremities in a metal cylinder, B, which forms a support, being provided for this purpose with a suitable base plate resting upon an insulating substance, C. A number of pads or rubbers, D, D^1, D^{11}, of ordinary con-

FIG. 1



struction are mounted upon a shaft or axis, H, passed through the centre of the cylinder, A, the said pads or rubbers revolving in contact with the interior of the said cylinder, A. The central axis, H, carries a number of hollow radial arms, g, g^1, g^{11}, and the rubbers are provided with corresponding rods, f, f^1, f^{11}, which slide in the said arms and are pressed outwards against the internal periphery of the glass cylinder by centrifugal force, so as to exert a pressure against the said cylinder, A, in proportion to the speed at which the shaft or axis H is caused to revolve. The elasticity of the working is augmented by the employment of springs, as shown, arranged between the rods, f, and the hollow arms, g. Bearings, V, V^1, mounted on standards, insulated or not from the ground, serve to support the central shaft or axis, H, which receives its motion from any suitable motor by the intervention of cranks, pulleys, or other convenient gear insulated if necessary, according to the force of the motive power employed. The electricity may be taken or discharged from the axis, H, of the rubbers, and from the metal cylinder, B. In case difficulty is experienced (contrary to what would appear probable from the experiments of Faraday upon the tendency of electricity to pass to the surfaces of bodies, even through non-conducting substances) in effecting the absorption of the electricity in this manner, the electricity may be discharged by the employment of points or other ordinary collectors arranged at m, m. These points may be arranged between the rubbers and rotate with the latter, being placed in communication with one another, and insulated from the axis of rotation.

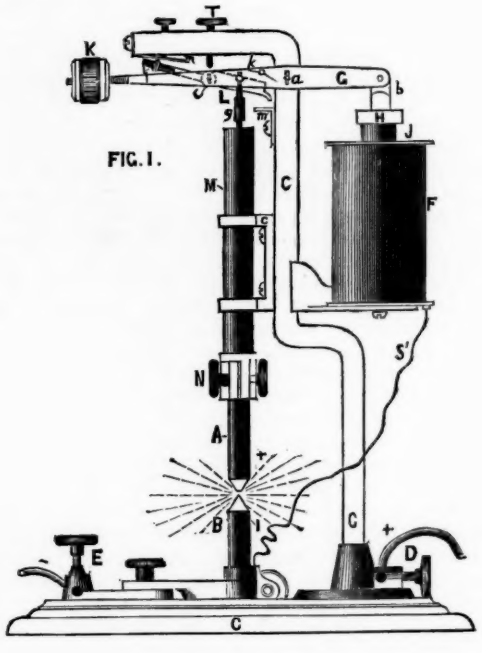
3405. "Telephonic and telegraphic apparatus." T. A. CONOLLY. Dated August 6. 8d. The chief object of the invention is to provide means whereby, in a telephonic exchange, the operations of the central office will be rendered automatic, so that the subscribers or members of the exchange may individually effect the requisite connection and disconnection of the lines, thereby avoiding the necessity of calling the central office, and having the service performed by manual labour, as is now customary.

3441. "Apparatus for generating electricity, &c." R. R. MOFFATT and S. CHICHESTER. Dated Aug. 9. 8d. Relates to certain improvements in magneto-electric machines for the conversion of mechanical into electrical energy, and in electric lamps or regulators for producing the electric light.

3464. "Electric brake." SIGMUND VON SAWICZESKI. Dated August 10. 6d. This brake is composed of an electro-magnet of a new and special form. This electro-magnet has at its upper and lower part two coils of a special form, whose circular external faces are made to a radius excentric to the wheel circumference, the internal being concentric to the outside of the wheel, and distant about half an inch from it when free.

4011. "Electric lamps." BRISTOW HUNT. (A communication from abroad by A. E. Brown, of the United States of America.) Dated September 17. 8d. Relates to arc electric lamps and has for its object a better regulation of the movement or movements of one or both of the carbons (as the case may be) to insure the maintenance of the carbon points continually in the proper relative positions to produce a perfect equality of resistance during the time of their consumption, and thus insure a perfect steadiness of the light. Fig. 1 is an elevation; and fig. 2, a vertical central cross section of an electric lamp embodying the invention, in a form in which it has been practically tested with perfectly satisfactory results. The operation of the apparatus may be thus explained. Assuming the parts to be in the condition in which they would be during the disuse of the lamp, and supposing the connection to be made between the binder posts and any suitable source of electricity, and then the carbons be separated (by hand in this case) a short distance, the current passes through the posts, frame, and carbons in the usual manner, and the

FIG. 1.



shunt current passing through the helices, F^1 and F, causes the axial magnetisms developed to draw downward the cores, I, J, to a certain extent. This movement of the armature or bar, H, vibrates the lever, G, in a manner to make it lift the plunger, f, suspended therefrom, which in turn lifts the tubular carbon-holder, M, N, thus further separating the upper from the (in this case stationary) lower carbon-point, and causing the required length of voltaic arc to be established. But as the parts of the machine make these motions, induced by the motive action of the said helices on said cores, the single (or free) end of the smaller lever, L, has its nut, l, thereby brought into contact with the stop, m; the said lever is turned on its fulcrum so that its forked end ascends, lifting the valvular plunger, e, the effect of which is to so open the ports of plunger, f, that the latter readily moves

within its tube, M, and the result of this condition of the apparatus is that the carbon holder, M, N, is allowed to descend to compensate for the consumption of the carbon points in the production of the light, which of course tends to increase the distance which originally existed between said points. But this feed of the upper carbon downward operates to establish immediately the proper degree of separation of the carbon, and the minimum degree of resistance to

FIG.2

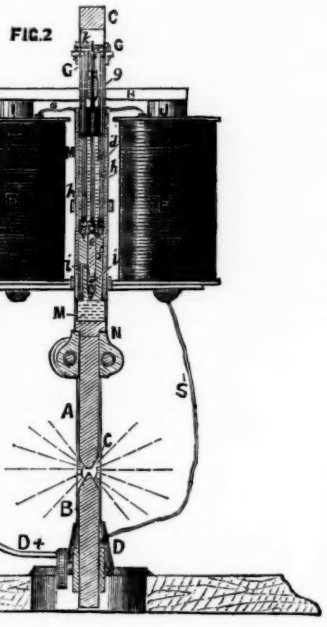
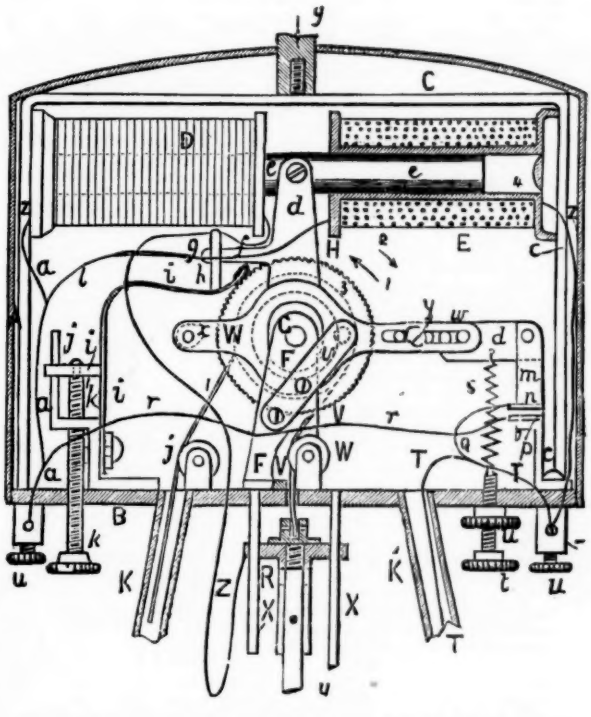


FIG.3

the current in the development of the proper arc, and thereby the energy of the "shunt" current and the axial magnetism of the helices, F¹, F, are so correspondingly decreased that the cores and armature, H, are allowed to slightly ascend, whereby the lever, L, is partially relieved from the operation of the stop, *m*, the result of which is that the valve, *e*, is forced to reassume its former relation to the plunger, *f*, closing or nearly closing the ports of the latter, and the said plunger, *f*, thus prevents any further ready descent of the tubular carbon holder, M, N. In the above condition of the several parts, the plunger, *f*, at all times however permits a very slow descent of the tubular carbon-holder, and it is only because this descent does not quite compensate for the destruction of the carbons (and the distance between their points therefore increases beyond the proper space) that the resistance to the main current becomes increased, and the energy of the "shunt" current thereby increased, to effect such a condition of the parts as above described as will permit a more rapid descent of the tubular holder, M, N.

4617. "Electric lamps." A. M. Clark. (A communication from abroad by H. B. Sheridan, of Ohio, America.) Dated October 21. 6d. The object of this invention is to prevent any change in the location or the intensity of the light of an electric lamp. Fig. 5 is a sectional side elevation of the upper part of the lamp. When the lamp is burning, an electric current passes from the positive binding post, U, along the wire, *a*, through the low resistance coil, D, along the wire, Z, through the carbons, S, S¹, along the wire, T, to the negative binding post, U¹, and on through the line circuit. At the same time a branch or second current passes from the positive binding post, U, along the wire, *b*, through the high resistance coil, E, along the wire, *c*, to the negative binding post, U¹, and on through the line circuit. The passage of the currents through the carbons brings the adjacent point of the said carbons to a glow heat, and at the same time the core, *e*, is attracted by the low resistance coil, D, and caused to enter farther into it. The forward movement of the core, *e*, moves the lever, *d*, forward and presses the plate, *h*, down upon the spring, *i*, and the spring, *i*, down upon the part, 3, of the cone pulley, H, turning the said cone pulley forward or in the direction of arrow 1. The forward movement of cone pulley, H, causes the chain, V, on the part, 2, of the said cone pulley, H, to be wound up, slightly raising the positive carbon, S. The same movement of the cone pulley, H, unwinds the chain, I, from the part, 1, of the said cone pulley, H, and lowers the negative carbon, S¹. By this separation of the carbons in connection with the passing electrical current the "voltaic arc" is established. The lamp will continue to burn with the various parts in the position described until the points of the carbons, S, S¹, become so much separated by combustion that the electrical current through the coil, D, becomes weaker than that through the coil, E. When this occurs the coil, E, becomes the stronger and attracts the core, *e*, causing it to move out of the coil, D, and into the coil, E, thereby moving the lever, *d*, in the same direction. This movement of the lever, *d*, raises the plate, *h*, from the spring, *i*, and moves the lever, *w*, in the same direction, the pawl, *x*, engaging with a tooth of the part, 3, of the cone pulley, H, and turning the said cone pulley in the direction of arrow, 2, thereby lowering the positive carbon, S, and raising the carbon, S¹. As the levers, *d*, *w*, have different fulcra, but are being connected together, the pawl, *x*, will travel faster and farther than the holding plate, *h*, and the cone pulley, H, will make its movement before being fully released from the spring, *i*. As the current is restored to the coil, D, by the approach of the carbons, S, S¹, the core, *e*, is again moved forward and the plate, *h*, is again pressed down upon the spring, *i*, thereby separating the carbons, S, S¹, to the proper distance to produce the arc. These various movements occur so nearly simultaneously and continuously that there is no perceptible change in the location or intensity of the light until the carbon holder, E, touches the plate, Y, and the carbons are so far separated by combustion as to break the circuit through them. The coil, E, now attracts the core, *e*, and moves the levers, *d*, *w*, but cannot restore the circuit through the coil, D, as

FIG.5.



the carbon, S, cannot move any farther downward, so that the core, *e*, will pass so far into the coil, E, that the movement of the lever, *d*, will bring the copper plate, *n*, in contact with the copper plate, *o*, and the electrical current will pass through the wires, *r*, *q*, and on through the line circuit. By this arrangement one lamp in a series can go out without in any way affecting the burning of the other lamps in the said series. The outer end of each of the coils, D, E, is closed with a vibrating plate, 4, whereby the sliding core, *e*, is retarded by the partial compression of air in one coil and the partial vacuum formed in the other, so that a too rapid movement of the said core is prevented. The vibrating plates, 4, also serve to keep dust out of the interior of the coil.

CITY NOTES.

Old Broad Street.

THE DIRECT SPANISH TELEGRAPH COMPANY LIMITED.

The 17th ordinary general meeting of the Direct Spanish Telegraph Company, Limited, was held in Cannon Street Hotel, on Friday last, Edmund Etlinger, Esq., occupying the chair, in the absence of Neil Bannatyne, Esq., chairman of the board.

The Manager (Chas. Gerhardi, Esq.) having read the notice convening the meeting,

The Chairman said he presumed that they would take the report (*see* Electrical Review of March 25th) and accounts as read. He continued: Before moving the adoption of the report I will make a few remarks upon it. The first paragraph of the report refers entirely to the state of the accounts, which shows a balance available for distribution on the 31st December last amounted to £4,910 13s. 10d. Perhaps you will kindly turn to the account on the other side. The balance sheet I need not examine, because there is no new capital and nothing more is spent on the capital account. The profit and loss account shows no feature of great importance. The first amount of £2,880 9s. 9d. was for Bilbao cable repairs, to which I shall presently refer, and there is a cash expenditure of £2,602 19s. 2d. On the other side, the amount received from telegrams amounts to £10,227 17s. 6d. Now in the corresponding half-year of 1880 the receipts were less than this amount by £1,170; and the expenses were less by £471; thus our expenses have increased £471; but we have, with that expenditure, realised an extra profit of £1,170; the difference therefore in the excess of profit made in the present year over the

former is £700. The question of working expenses of course requires careful examination, and we find that they bear a very favourable proportion and that they are not more than they should be. I now go to the second paragraph, and that paragraph shows that the receipts are in excess of those for any previous half-year since the formation of the company. The nearest approach to that half-year was in 1875—December. The receipts for the half-year were £9,753, while our present receipts are £10,228. I wish to draw your attention to a marked difference between the two periods. In December, 1875, we had the Carlist War on in Spain, and the bulk of our receipts originated from military and diplomatic messages, which, of course, is a very temporary source of revenue. At present the bulk of receipts are due to an increase of activity in trade in Spain; and I have put down here a few figures to show how this activity has increased within the last three years, if measured by our receipts. During the half-year ending December, 1878, our receipts were £5,741; during the half-year ending December, 1879, they rose to £7,405; during the half-year ending December, 1880, they rose to £9,058; and during the half-year ending December, 1881, they rose to £10,228. Now, the difference between 1881 and 1880 is not so great as that between 1880 and 1879; but the reason is that in 1881, during November and December, our Bilbao cable was down for eighteen days, and consequently we lost a great deal of traffic; otherwise, no doubt, the increase would have been almost the same. Now, as regards the present traffic, though that is not a question which actually arises to-day at the meeting, it may be interesting for you to hear that the increase keeps on steadily. In January this year our receipts have been £2,055; in February, £2,109; and in March, estimating to-day, they are £2,280, making a total receipt for the three months of £6,444, which is equal to £12,888 for the half-year, if everything goes well during the next three months. Now the next paragraph refers to a breakdown of the Bilbao cable in November and December, last. The cable parted at about 12½ miles from the Spanish coast, in eighty fathoms of water. It was found that the cable had been laid on a narrow ledge of rock, and the motion of the waves on the cable had severed it, at least its outer coating. The ship went out and picked up four miles of cable, which was of the deep-sea type, and went out to sea till she got to ninety fathoms. They found the cable was perfect, and then they cut out the bad piece and substituted four miles of a better, heavier type of intermediate cable. That cable is put down now, and I have every reason to hope that it will last a great deal longer than the other did; but at the same time it is only fair to say that that cable lasted on that ledge of rock for nine years, consequently it was not a bad life in such a bad place. Here it is, and you will also find on the other table the piece which was severed by the action of the waves. As to the cost of these repairs, they certainly look rather heavy, but you will remember in October last, after the gales, a great many cables were broken down—in fact, no ships were to be had to repair them—not a single suitable ship was to be got in England, and we had to go abroad to find a ship. Fortunately we found one in the north of Europe, in Copenhagen, though of course we had to accept such terms as people imposed upon us, because we could not lose our traffic. We had to pay heavily for a ship, but on the other hand, she did her work very well. She got to London a few days after she was chartered, left the Thames on December 11th, steamed to Bilbao—nearly 900 miles—picked up the cable, mended it, inserted four miles of new cable, and finished the whole operation on the 15th Dec. So she did her work remarkably well, and considering the time spent over it, made a very good bargain, though of course if the weather had been bad she might have been delayed for weeks. Altogether, although we have paid dearly for it, we have nothing much to complain of. The next paragraph refers to how we paid for this repair. Of course the question arose how it was to be defrayed. The directors always considered that this company's strength lay in the way of a good reserve. Now if we had taken this £3,200 out of the reserve of £5,500 it would only have left £2,300, and we came to the conclusion that that was too small to face probable future contingencies, and the directors therefore determined to pay for the whole of these repairs out of the revenue for the current year, with the exception of £300, which was taken from the reserve for the purpose of making round numbers, but practically the revenue paid for the whole of it. That course may seem to some of you to have been rather hard, but upon the whole the directors were satisfied that it was for the interests of the company that it should be so. The next paragraph refers to the payment of dividends on which a resolution will be submitted to you in the usual way. It is proposed to pay 10 per cent. less income tax on the preference shares, and there will then be left for the ordinary shareholders, 3s. per share free of income tax. The next paragraph, paragraph 6, states that we are expecting a remittance for the last three months of 1881 from Spain, wherewith to pay our dividends, and that we expect these by the latter end of April. I am glad to say that we received advices yesterday that they may be expected in London on April 5th, and the moment they are received, of course the dividend warrants will go out. I have only one more remark to make, that our cables are being constantly tested, and the result of these tests has enabled our electrician to state that the cables are in excellent electrical condition; in fact the insulation is better than when the cables were put down. And the same may be said of the underground land lines, which were put down in 1880, from the Lizard to Falmouth, so as to make Falmouth the terminus, instead of the Lizard. They were put down by Mr. Gerhardi himself, and have done remarkably well, and given every satisfaction. I do not think I have any other remark to make, but before moving the adoption of the report I should be glad to answer any question which may be wished to be put.

No questions being put, the Chairman said: I wish then to move the first resolution, "That the report and accounts now presented be and hereby are received and adopted."

Mr. Abraham Scott seconded the motion, which was carried unanimously.

The second resolution: "That the preference dividend, at the rate of 10 per cent., less income-tax, and a dividend of 3s. on the ordinary shares, free of income-tax, both for the half-year ending December last, be and hereby are declared," was also put by the Chairman, seconded by Mr. Scott, and carried unanimously.

The Chairman; I have much pleasure in moving, That the two retiring directors, Mr. Abraham Scott and Mr. Neil Bannatyne, be and hereby are re-elected.

Mr. Dyet seconded the motion, which was carried *nem. con.*

Mr. Scott said: On behalf of Mr. Bannatyne and myself, I beg to thank you for your confidence in re-electing us; and I think I can say that we shall continue to use our best efforts for the interest of the company.

Mr. Hankey moved that Mr. James Cowan be appointed auditor for the present year, at the remuneration of 10 guineas.

Mr. Hooper seconded, and the motion was carried.

On the motion of Mr. Dyet, seconded by a shareholder, a vote of thanks to the chairman and board of directors was unanimously carried, after which the proceedings terminated.

THE ELECTRIC LIGHTING CONTRACT AND MAINTENANCE COMPANY.—The directors of this Company at the recommendation of numerous and influential applicants for shares, announce their intention, immediately after allotment, to call a general meeting of shareholders with a view to subdivision of the shares into shares of £5 each, upon which not more than £2 10s. will be called up.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations. April 4.	Business Done.
		ELECTRIC LIGHT.			
40,000	10	Anglo-American Brush Co.	4	10½ - 10⅝	10½-⅜-½-10
		Do. Do.	10	23½ - 24½	23½
150,000	1	Electric Light and Power Generator Co.	1	¾ - 1	¹³⁄₁₆-¹³⁄₁₆-¹³⁄₁₆
		TELEGRAPHS.			
2,116,400*l.*	Stk.	Anglo-American, Limited	100	53½ - 53⅝	53½
2,441,800*l.*	Stk.	Do. Preferred (Def'd. receiving no div. until)	100	83 - 84	83⅝.3
2,441,800*l.*	Stk.	Do. Deferred (6 p. c. has been paid to Pref.)	100	24½ - 24⅝	24½
130,000	10	Brazilian Submarine, Limited	10	10⅝ - 11¼	11⅛.11.¹⁵⁄₁₆ xd
16,000	10	Cuba, Limited	10	8 - 8½	
6,000	10	Do. 10 per cent. Preference	10	15½ - 16½	
13,000	10	Direct Spanish, Limited	9	6 - 6½	
6,000	10	Do. 10 per cent. Preference	10	15½ - 16½	
65,000	20	Direct United States Cable, Limited, 1877	20	11¼ - 11½	
100,000*l.*	100	Do. 6 per cent. Debenture, repayable 1884	100	101 -104	
380,000	10	Eastern, Limited	10	10 - 10½	10⅛.⅜
70,000	10	Do. 6 per cent. Preference	10	12⅝ - 13	
232,000*l.*	100	Do. 6 do. Debentures, repayable Oct. 1883	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1887	100	101 -104	
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	102 -107	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11⅛ - 11⅜	11⅛
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	100	106 -110	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	103 -106	
140,000	100	Do. do. registered, repayable 1900	100	103 -106	
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 -105	
254,300*l.*	100	Eastern and South African Limited 5 per cent. (Mort. Deb. Registered redeemable 1 Jan. 1900)	100	103 -106	
345,700*l.*	100	Do. do. do. To Bearer	100	103 -106	
22,050	10	German Union Telegraph and Trust, Limited	10	9⅛ - 9⅜	
163,390	10	Globe Telegraph and Trust, Limited	10	6⅛ - 6⅜	6⅛.⅞
163,209	10	Do. 6 per cent. Preference	10	12⅛ - 12⅜	12⅛.⅜.⅝
125,000	10	Great Northern	10	12⅝ - 13⅛	
100,000*l.*	100	Do. 5 per cent. Debentures	100	102 -105	104
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	24 - 25	
100,000	100	Do. 6 per cent. Debentures, 1886	100	101 -105	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4⅜ - 5⅛	
12,060	10	Mediterranean Extension, Limited	10	1⅝ - 2⅛	
8,200	10	Do. 8 per cent. Preference	10	8⅛ - 9	
9,000	8	Reuter's, Limited	8	13 - 13½	
280,000	Stk.	Submarine	100	260 -270	
58,225	1	Do. Scrip	1	2⅛ - 2½	
4,200	Cert.	Submarine Cables Trust	100	101 -104	
37,350	12	Telegraph Construction and Maintenance	12	30 - 31	30½
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -105	102⅝
186,750	5	Do. 2nd Bonus Trust Cert.	5	1⅛ - 1⅜	1⅛
30,000	10	West Coast of America, Limited	10	4⅜ - 5⅛	
150,000	100	Do. 8 per cent. Debentures			
69,910	20	Western and Brazilian, Limited	20	8⅛ - 8⅜	8⅛.¼
200,000*l.*	100	Do. 6 per cent. Debentures "A" 1910	100	105 -110	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80, red. Feb., 1910	100	98 -101	
1,500	$1,000	Western Union of U. S. 7 p.c. Mort. (Building) Bds.	$1,000	124 -129	
1,030,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	102 -105	
88,321	10	West India and Panama, Limited	10	1⅝ - 2⅛	1⅝-2.¹⁵⁄₁₆.2.1⅛
34,563	10	Do. 6 per cent. 1st Preference	10	8⅛ - 8⅜	8⅛.¼
4,669	10	Do. 6 do. 2nd do.	10	6½ - 7	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅜ - 1⅝	
200,000	1	Oriental Telephone Co.	½	⅜ - ½	
100,000	5	United Telephone Co.	5	13½ - 13⅝	13½.⅝

TRAFFIC RECEIPTS.

Direct Spanish Telegraph Company, Limited. The traffic receipts for the month of March, 1882, were £2,332, against £1,492 in the corresponding period of 1881.

Great Northern Telegraph Company. The receipts in March, 1882, were £19,680, from January to 31st March, 1882, £53,640, and for corresponding months of 1881 and 1880, £53,224 and £47,935 respectively.

The Brazilian Submarine Telegraph Company. The receipts of this Company for the week ending April 1st were £3,402.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending March 24th, 1882, were £2,418, and for the week ending April 1st, were £2,212, both after deducting the "fifth" of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited

The West India and Panama Telegraph Company, Limited. The estimated traffic receipts for the half month ended the 15th March are £3 430, as compared with £2,539 in the corresponding period of 1881, and for the half month ended the 31st March, £3,915, as compared with £2,645 in the corresponding period of 1881. The December receipts, estimated at £4,796, realised £4,582.